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Review Article

Magnetic resonance imaging in pelvic endometriosis with surgical correlation: a pictorial review

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ABSTRACT

Endometriosis is a common gynaecological problem, primarily affecting women of reproductive age. Most common site of endometriosis is ovaries. Extra ovarian sites include uterine ligaments, fallopian tubes, rectosigmoid, laparotomy or C-section scars and urinary bladder. There can be formation of ovarian endometriotic cysts or deep infiltrating endometriosis. The role of MRI is in the evaluation of deep or more complex disease as it enables a large field of view, superior contrast resolution and multiplanar capabilities as compared to ultrasound. In this article, we are describing MRI imaging appearances of endometriomas and deep pelvic endometriosis in the form of a pictorial essay.

Keywords: Magnetic resonance imaging, Pelvic endometriosis, Endometriosis surgery

INTRODUCTION

Endometriosis is a common gynaecological problem, primarily affecting women of reproductive age. It has a prevalence of 5-20%.[1] Endometriosis is the implantation of functional endometrial glands and stroma outside the uterus. The presence of ectopic endometrial tissue within the myometrium is termed as adenomyosis. The underlying cause is not known with several theories yet to be proved.[2] Endometriosis can be asymptomatic or can present with-dysmenorrhoea, dysparunia and infertility.[3] Unusual symptoms correlate with atypical site of disease e.g., pneumo or hematothorax with pleural deposition; cyclical headaches with intracranial lesions. Disease severity does not always correlate with disease extent and is more closely linked to site of involvement. Most common site of endometriosis is ovaries. Extra ovarian sites include uterine ligaments, fallopian tubes, rectosigmoid, laparotomy or C-section scars and urinary bladder.[4] Rarely extra-peritoneal sites including lung, CNS can be involved. Definitive diagnosis is based on laparoscopy (gold standard). Ultrasound is the primary and most common imaging modality for the assessment of endometriosis. Both transabdominal and transvaginal ultrasound studies should be performed. The most important use of ultrasound is in the evaluation of pelvic endometriotic cysts. The role of ultrasound in imaging endometriotic deposits elsewhere is limited and is highly operator dependent. The role of MRI is in the evaluation of deep or more complex disease as it enables a large field of view, superior contrast resolution and multiplanar capabilities as compared to ultrasound. Endometriomas are well demonstrated on MRI. They appear as high signal on T1W images with shading on T2W images with no loss of high T1 signal on fat saturated sequences, thus differentiating them from dermoids.[5] In this article, we are describing imaging appearances of endometriomas and deep pelvic endometriosis in the form of a pictorial essay.

MRI IMAGING PROTOCOL

MRI is performed irrespective of the day of the menstrual cycle. Intravenous antispasmodic agent scopolamine-N-butyl bromide, is administered immediately before the

examination to reduce motion artefacts caused by peristalsis and to attenuate uterine contractions. Images were acquired on a 1.5-T imager (Philips). Axial T1-weighted sequence; axial, coronal and sagittal T2W; axial T1 fat suppressed; axial DIXON and DWI sequences are done. Intravenous administration of a gadolinium chelate is given in some cases, and axial, coronal and sagittal fat-saturated T1-weighted images are then acquired 10 seconds after the injection of the contrast.

PRIMARY FINDINGS ON MRI

Endometriomas

These are cysts that occur in the ovaries as a result repeated cyclic haemorrhage. These cysts have thick walls and degenerated blood products as a result of which they give an appearance of "chocolate cysts." They are hyperintense on T1W and T1W fat saturated sequences and are hypointense on T2W sequences due to "shading artefact" explained by the presence of blood products in various stages (Figure 1).[6,7]

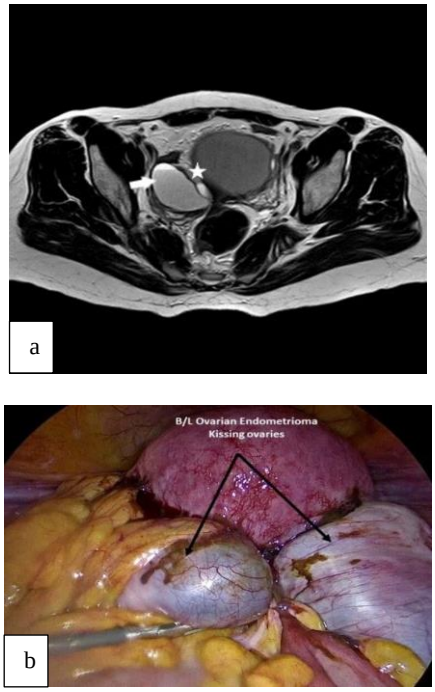

Figure 1: In a 39-year-old female with complaints of heavy menstrual bleeding and dysmenorrhea, well defined cystic lesions are seen in B/L adenexal region with kissing ovaries (star) and shading effect (arrow) seen in right ovarian lesion in axial T2W image (a) and; (b) intra-operative picture of the same patient depicting bilateral endometriomas with kissing ovaries sign.

Deep infiltrating endometriosis

It refers to the presence of endometrial implants at a depth of more than 5 mm in sub peritoneal region. Patients usually present with complaints dysmenorrhea, menorrhagia, dyspareunia and symptoms in relation to the organs infiltrated by the endometriosis implants. It can occur at extra ovarian sites include uterine ligaments, fallopian tubes, rectosigmoid, laparotomy or C-section scars and urinary bladder. Patients usually present with complaints of dysmenorrhea, menorrhagia, dyspareunia, and symptoms concerning the organs infiltrated by the endometriosis implants.

Various theories have been proposed to explain the etiopathogenesis of endometriosis but the most accepted one is "metastatic theory". According to this theory, there is a retrograde flow of blood through the fallopian tubes. This can be due to many factors like obstruction. This results in the ectopic insertion of endometrial implants which occurs most often in dependent areas of the pelvis.

These ectopic rests of active endometrium cause fibromuscular proliferation and respond to hormonal stimulation resulting in cyclical hemorrhage. In cases of bowel, there is infiltration of the serosa and muscular layer by the endometrial tissue resulting in the formation of nodules, strictures, and obstruction. Similar fibromuscular invasion occurs in other organs resulting in nodularity. These areas of nodularity appear as hypointense structures on all sequences. Multiple T2W hyperintense foci can also be seen representing dilated endometrial glands. These foci can be of variable signal intensity on T1W images depending upon the presence or absence of blood.[8,9]

Involving urinary bladder and ureters

Urinary bladder involvement in endometriosis occurs by the ectopic endometrial implants over the serosal surface of the bladder. Intramuscular invasion is very less common. Therefore, MRI is very important to detect urinary bladder involvement as serosal involvement can occur even if cystoscopy is normal or there are no urinary symptoms. Similarly, if there is ureteral involvement, only superficial implants occur which can be seen as hypointense nodules. Hence, whenever evaluating a case of deep pelvic endometriosis, a radiologist should have a keen eye and specifically look at the urinary bladder and ureters for any nodularity as usually there are no urinary symptoms.[10,11]

Involving uterosacral ligaments

When the endometrial glands invade the smooth muscles and fibromuscular tissue, there is a fibrous reaction with resultant formation of nodules. Hence, deep endometriosis involving uterosacral ligaments is seen as thickened or nodular uterosacral ligaments on T2W images. Post-contrast enhancement may sometimes occur due to inflammatory reactions. Fallopian tubes involvement is associated with infertility. Over time, fibrotic reactions occur leading to the formation of adhesions. If these adhesions involve fallopian tubes, then there is the formation of hydrosalpinx. Hemorrhages within the endometrial implants lead to the formation of

hematosalpinx. Hyperintense foci on T2W images correspond to dilated glands and hyperintense foci on T1W images, if present, represent blood. (Figure 2).[12,13]

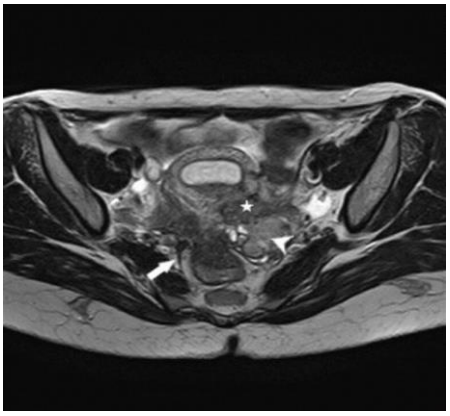

Figure 2: Axial T2W image shows multiple irregular hypointense deposits at torus uterinus (star), left ovarian endometrioma (arrowhead) and thickened uterosacral ligaments (white arrows).

Involving retrocervical area and torus uterinus

In involvement of the posterior compartment by endometriosis, there can be implants in the pouch of Douglas, rectum, rectouterine pouch, torus uterinus, posterior vaginal fornix, and rectovaginal septum. Findings of deep pelvic endometriosis are the same in these regions as at other sites. Fibrosis and adhesions can also form resulting in obliteration of pouch of Douglas. When lesions are located at the torus uterinus, uterine retroversion and rectal angulation can occur due to fibrosis (Figure 3).[14,15]

Involving the bowel

The most common intestinal segment involved is the rectosigmoid and infiltration through the muscular layer can cause adhesions and obstruction. Although, most often the mucosa is not invaded and only superficial implants are present. There can be marked muscular hypertrophy of rectosigmoid appearing hypointense on T2W images with hyperintense mucosa and sub mucosa-giving the mushroom cap sign. Implants are seen on the serosal surface of uterus, most commonly at torus uterinus and appear as T2W hypointense endometriotic plaques. Foci of T1 hyperintensity may or may not be present (Figure 4).[16,17]

EXTRAPERITONEAL ENDOMETRIOSIS

Endometriotic implants can occur post-operatively at the surgical scar, most often, following a history of caesarean section or laparoscopy. Thisresults due to direct implantation of endometriotic tissue at these sites during surgery. Symptoms of pain and discomfort especially during menstruation occur. Radiologically, there is the presence of lesions with similar characteristics to endometriotic implants at the scar site (Figure 5).[18]

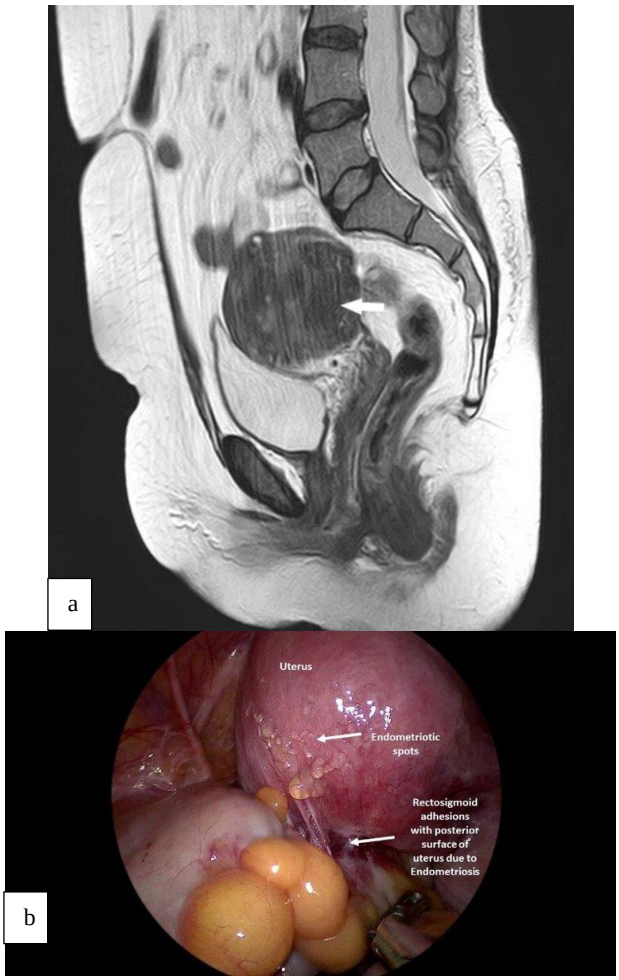

Figure 3: In a 40-year-old female with complaints of abdominal pain and menorrhagia there is e/o focal asymmetrical thickening of the junctional zone forming an area of low signal intensity (arrow) with few tiny hyper intense foci within it on (a) sagittal T2W image; endometriotic plaque is seen at torus uterinus; laparoscopic image (b) of the same patient showing endometriotic spots at torus uterinus and rectosigmoid adhesions with posterior surface of uterus.

Endometriomas Can Transform into Clear Cell or Endometrioid Epithelial Ovarian Carcinomas-

Women with endometriosis are at risk for developing both clear cell and endometrioid subtypes of epithelial ovarian cancer. Endometriosis is one of several benign causes of an abnormal CA-125 level, thus, an elevated biomarker value in isolation is not specific for endometriosis-associated ovarian cancer. Human epididymal secretory protein E4 level is elevated in women with either endometriosis-associated or conventional ovarian cancer, but not in women with benign endometriosis. Specific finding of malignant transformation of an endometrioma is

the development of enhancing mural nodules. (Figure 6).[19,20]

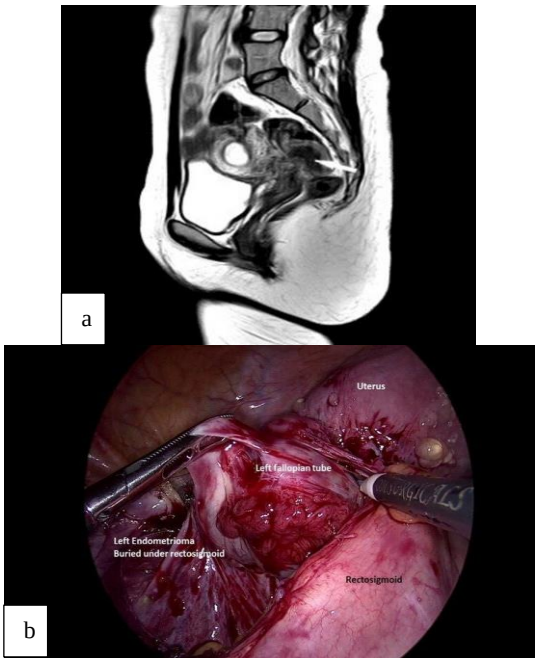

Figure 4: In a 25-year-old patient with complaints of lower abdominal pain for 2 years (a) sagittal T2W shows an ill-defined area of reduced T2W signal in posterior myometrium of lower uterine segment; there is marked muscular hypertrophy of rectosigmoid appearing hypointense on T2W images with hyperintense mucosa and sub mucosa (white arrow)-giving "mushroom cap sign" s/o deep infiltrating endometriosis involving the rectosigmoid; (b) Intra-operative image showing infiltration of rectosigmoid.

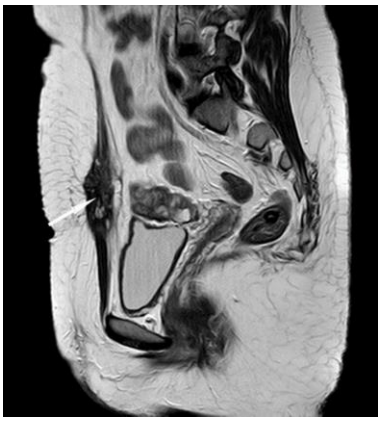

Figure 5: In a 33-year-old female with h/o prior caesarean section, there is an ill-defined lesion with mild speculations seen in the anterior abdominal wall involving both the rectus muscles with minimal extension into the subcutaneous tissue; the lesion shows hypointense signal on T2W images (white arrow) s/o scar endometriosis.

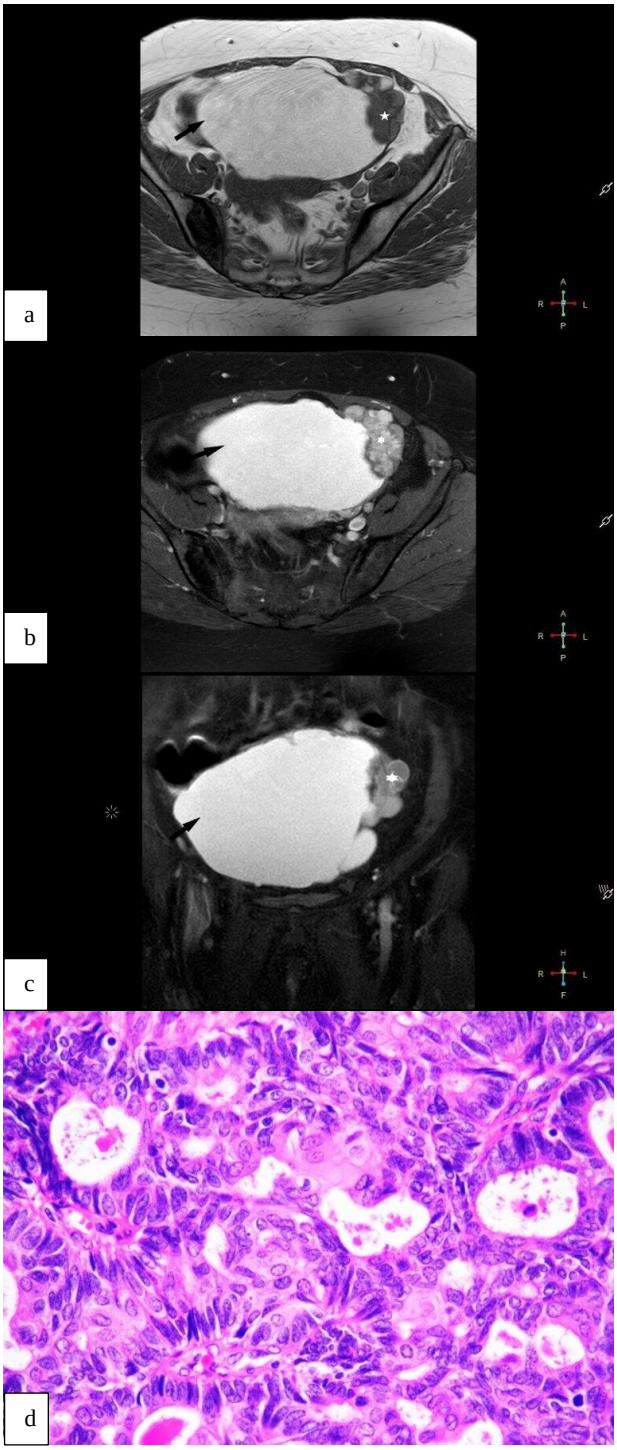

Figure 6: A 44-year-old female, diagnosed case of left ovarian endometrioma for 10 years, came for CEMRI Pelvis with complains of increased pelvic pain. Axial T1 (a), T1FS (b), and coronal T1SPIR post gad (c) images show a large endometrioma in left ovary (thick arrow) with irregular soft tissue component showing diffusion restriction and post contrast enhancement (star) was demonstrated. Possibility of malignancy in endometrioma was given. The endometrioma along with soft tissue component was resected and on histopathology, clear cell carcinoma was confirmed (d).

CONCLUSION

Endometriosis can be missed or misdiagnosed and it can be cause a great amount of morbidity to the patient. Many sites of deep pelvic endometriosis can be missed on ultrasound or it can mimic other diseases. The role of MRI is in the evaluation of deep or more complex disease as it enables a large field of view, superior contrast resolution and multiplanar capabilities as compared to ultrasound. Therefore, understanding of MRI for diagnosis of endometriosis is useful for accurate diagnosis and extent of disease which has many implications for a surgeon's point of view as most appropriate surgical approach can be chosen.

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