Deep pelvic endometriosis: MR imaging features

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Imaging protocol

The MR examinations were performed on a 1.0 Tesla magnet (Gyroscan, Philips, Best, Netherlands) using a phase-array surface coil. The imaging sequences included T2-weighted (T2W) images (TE = 90 ms, TR = 3500 ms, slice thickness 3 mm, interslice gap 1 mm) in 3 planes, a T1W sequence (TE = 14 ms, TR = 550 ms, slice thickness 3 mm, interslice gap 1 mm), usually in the sagittal plane, and noncontrast fat-suppressed (spoiled inversion recovery SPIR) T1W images in 3 planes.

The T2W images provided excellent contrast resolution for evaluation of pelvic anatomy. The selected slice thickness must be a compromise between the need for high spatial resolution obtained with thinner sections and acceptable SNR. In our center, we use a 3 mm slice thickness with 1 mm interslice gap.

Noncontrast fat-suppressed T1W images are useful to facilitate the detection of hyperintense hemorrhagic implants of endometriosis (8).

Vaginal opacification using 20 ml of sterile US gel and rectal opacification using

50 ml of gel is advocated by some groups. This technique is well tolerated by patients after the procedure and its purpose have been carefully explained (9). It provides improved visualization of the rectovaginal space and cul-de-sac, regions that frequently are involved by deep endometriosis.

Some groups use peristaltic inhibitors to reduce GI tract artifacts. In our practice, we do not use such agents because an intravenous injection would be required and these artifacts do not significantly interfere with image interpretation. A Gadolinium based intravenous contrast agent is not always used. It could allow improved depiction of areas of active inflammatory reaction (5). However, no consensus on the use of these contrast agents exists, and excellent results have been reported without the use of postcontrast imaging (10). A recent publication using contrast enhanced dynamic MR imaging of nodular endometriosis demonstrated the utility of time-intensity curves of lesions and uterine endometrial tissue in the diagnosis of implants of endometriosis (11).

In summary, to adequately evaluate endometriosis on MR, vaginal opacification with US gel, “anatomical” non-fat-suppressed T2W images, and fat-suppressed T1W images, preferably in the axial and sagittal planes, are needed.

**MR imaging features of deep pelvic endometriosis**

MR is the best imaging modality to map deep implants of endometriosis. Bazot et al. reported overall sensitivity and specificity values of 90.3% and 91% respectively for all deep locations included (12). The most frequent locations of implants and adhesions are summarized in table I (13). On MR, implants may present with three main imaging features (14, 15):

- Implants with large glandular component and minimal fibrous reaction: these lesions are T2W hyperintense, with areas of spontaneous T1W hyperintensity due to hemorrhage and show enhancement after Gadolinium injection.
- Fibrous masses: these lesions appear spiculated with retraction, show T1W and T2W hypointense signal, with variable enhancement, frequently minimal.
- Mixed: fibrous masses with punctate foci of T1W and T2W hyperintensity.

The classification systems for deep pelvic endometriosis described in the literature often are complex. For descriptive purposes, we will use the classification proposed by Del Frate et al. distinguishing posterior cul-de-sac lesions subdivided into 3 types (fig. 1) from anterior cul-de-sac lesions including endometriosis of the bladder detrusor (5). We will also describe the MR imaging features of cul-de-sac obliteration.

**Rectovaginal septum lesions (type I)**

The rectovaginal space is situated within the rectovaginal septum between the posterior wall of the vaginal mucosa and the anterior wall of the rectal muscularis. Rectovaginal septum lesions account for only about 10% of cases of posterior cul-de-sac lesions. The lesions often are small
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with spontaneous T1W hyperintensity and variable T2W signal intensity (fig. 2).

Posterior wall fornical lesions (type II)

These implants develop from the posterior fornix toward the rectovaginal septum, without extension to the septum itself or the rectal wall. The uterine fornix corresponds to the region of the uterine cervix at the level of the uterosacral ligaments along the superior half of the posterior cervix. This is the most frequent site of posterior cul-de-sac involvement. Involvement of the uterosacral ligaments is frequent. The normal uterosacral ligaments are routinely visualized on axial and sagittal T2W images. They are concave from anterior to posterior between the uterine fornix to the sacrum coursing on both sides of the rectum (fig. 2). Uterosacral ligament involvement is characterized by the presence of a nodular lesion typically at their insertion on the cervix, asymmetry of the ligaments, or only the presence of irregularity (14). Implants may be undetectable in patients with prolapse of small bowel loops in the pelvis.

Type II lesions extend asymmetrically along the uterosacral ligaments (fig. 4). The implants are best depicted on T2W images. They present as spiculated hypointense masses with retraction, frequently containing small T1W and T2W hyperintense foci. Small lesions may only cause subtle areas of signal abnormalities. In such cases, vaginal opacification with US gel resulting in straightening of the vaginal fornices may be valuable for improved detection and diagnosis (fig. 5).

Hourglass-shaped lesions (type III)

Hourglass-shaped lesions occur when posterior fornical lesions extend cranially to the anterior rectal or sigmoid wall. The lesion component along the anterior bowel wall is fairly similar in size to the component next to the fornix. A thin connection between both components is present and routinely visualized on MR, creating an hourglass appearance. These lesions always occur under the peritoneal fold of the cul-de-sac of Douglas. They often are large, facilitating diagnosis. The injection of Gadolinium-based contrast may be helpful to demonstrate the presence of bowel wall enhancement, suggesting underlying invasion (fig. 6 and 7).
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Fig. 5: Axial T2W images.

a On the initial sequence, the lesion is difficult to detect.

b Vaginal opacification with US gel (b) distends the vaginal fornices allowing excellent depiction of this small type II fibrous mass of the posterior uterine fornix extending to the left uterosacral ligament (arrow).

Fig. 6: Sagittal (a) and axial (b) T2W, coronal T1W SPIR (c) and axial postcontrast T1W SPIR (d) images.

Large type III fibrous mass of the uterine fornix, filling the cul-de-sac (arrows a, b) containing a few small hemorrhagic T1W hyperintense foci (arrow c). Rectal wall enhancement indicating involvement (arrow d) and confirmed on endoscopy.
Rectosigmoid colon involvement

Combined involvement of the cul-de-sac and rectosigmoid colon is discussed above. For evaluation of this anatomical region, both MR and endoscopic US achieve similar results. None of these techniques can accurately determine the depth of infiltration (4). Rectal opacification prior to MR imaging may be helpful to detect the presence of rectal involvement (13). In addition, isolated colonic involvement by implants of endometriosis without contiguous cul-de-sac involvement may also occur (fig. 8).

Anterior cul-de-sac lesions and endometriosis of the bladder detrusor

It is relatively rare and frequently asymptomatic. Involvement progresses from disease of the vesicouterine cul-de-sac invading into the bladder wall. Bladder invasion may extend from the preuterine peritoneum though the peritoneal fold into the supravesical space (metastatic origin) or occur from primary involvement of the supra-vesical extra-peritoneal space (metastatic origin) and peritoneum. Implants may remain superficial, especially at the bladder dome, but infiltration of the bladder wall may also occur (15). On imaging, bladder involvement is characterized by focal wall thickening that may simulate a bladder tumor. On MR, these lesions typically are heterogeneous and T2W isointense, with irregular margins and occasional T1W hyperintense foci. US also is excellent for detection of bladder involvement. Lateral extension to the ureters may cause ureteral stenosis and hydronephrosis. Finally, rare cases of isolated lateral bladder wall involvement with implants at the ureterovesical junction have been reported.

Obliteration of the cul-de-sac of Douglas

Local inflammation induced by these different lesions of deep pelvic endometriosis eventually cause fibrotic obliteration of the cul-de-sac. Adhesions cause dorsal tilt of the uterus, loss of physiological rectal curvature, inferior displacement of pelvic bowel loops into the cul-de-sac and elevation of the vaginal fornix. The MR features of fibrotic obliteration of the cul-de-sac are characterized by five main findings (fig. 10) (6):

- retroflexed uterus.
- elevated posterior vaginal fornix.
- tethered appearance of the rectum in the direction of the uterus.
- intestinal tethering in the direction of the uterus.
- fibrotic plaque and/or nodule covering the serosal surface of the uterus.

We believe that vaginal opacification with US gel is valuable to facilitate detection of these imaging features. The association of severe dysmenorrhea with cul-de-sac adhesions has been observed in previous studies and aggressive surgical resection has been shown to provide symptomatic improvement. Kataoka et al. reported a mean accuracy of 71.9% (6)
for the diagnosis of posterior cul-de-sac obliteration. However, as stated by the authors, the study was conducted over a 10-year period during which time significant technical advances were achieved and current results are probably improved. This could be confirmed by further studies. The imaging-based diagnosis of cul-de-sac obliteration is important because transvaginal laparoscopy is contraindicated since adhesions will preclude adequate evaluation of pelvic organs. Also, it is associated with intestinal involvement in over 80% of cases, requiring a multidisciplinary surgical approach.

**Conclusion**

MR is accurate for mapping of deep pelvic endometriosis, a disease frequently associated with significant clinical symptomatology. The imaging protocol includes “anatomical” T2W images as well as fat-suppressed T1W images. MR allows accurate presurgical mapping, but radiologists must remain alert because implants of endometriosis may have variable imaging appearances, involve multiple closely related anatomical structures and cause only subtle signal alterations. The use of an optimized imaging protocol combined with a careful review of the acquired imaging data usually allows appropriate surgical management, often the only therapeutic options able to improve the quality of life of severely afflicted patients.
Fig. 10: Features of fibrous obliteration of the cul-de-sac of Douglas.

a Retroflexed uterus and fibrous mass of the uterine fornix (arrow). Subserosal uterine fibroid (star).

b Elevated posterior vaginal fornix (arrow) well depicted by the endovaginal gel.

c Intestinal tethering (arrows) in the direction of the uterine fornix due to adhesions.

References


