Deep pelvic endometriosis: MR evaluation

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Learning objectives

-**Deep endometriotic** implants in the pelvis are not as common as ovarian endometriosis, but they are more frequently related with clinical symptoms and infertility.

-When medical treatment fails to control symptoms, surgical excision of the endometriotic foci is the treatment of choice.

-MRI is the best imaging technique to preoperatively detect and stage deep endometriotic implants in the pelvis, but a dedicated **MR protocol** is needed. Patient preparation is also commented.

-Many times, MRI **findings are subtle** and a careful analysis of the images is recommended to do not overlook lesions that can be related with patient's symptoms.

-MR findings of deep pelvic endometriosis in different locations are shown and the **advantages** and **limitations** of the technique are discussed.
Background

Endometriosis is defined as the presence of endometrial tissue in an ectopic location, outside of the uterine cavity. It is frequent among women in childbearing age. Endometriosis is often almost asymptomatic but it is among the leading causes of infertility and pelvic pain.

The most frequent locations for the endometriotic implants are the ovaries and the peritoneal surface. Pathogenesis of this disease is under discussion and it is probably multiple. Most of the endometriotic lesions could be explained by the theory of the "retrograde menstruation" from the uterine cavity through the Fallopian tubes to the peritoneal cavity. These endometrial cells can then grow deep into subperitoneal tissues. Although uncommon, there are also endometriotic lesions in organs located outside the abdomen (e.g.: pleura, skin, nose, central nervous system) that can only be explained by metaplasia or hematogenous dissemination.

Deep pelvic endometriosis is defined by the presence of endometrial tissue implants penetrating more than 5 mm under the peritoneal surface. Incidence of these deep implants is much lower than of the superficial peritoneal endometriosis, but deep endometriosis is related with more pronounced clinical symptoms.

Deep endometriosis usually affects the posterior pelvic spaces.

- The more frequent locations are: Douglas pouch, vaginal vault, rectovaginal septum, uterosacral ligaments, torus uterinus and intestinal wall (habitually in the rectum or sigmoid colon).

- The urinary system can be affected. Ureters can be extrinsically involved by deep pelvic endometriotic implants located posterolaterally in the pelvis and the urinary flow can be impaired.

- Deep endometriosis in the anterior compartment of the pelvis is less common. From the vesicouterine recess, the implant can penetrate to the muscular wall of the urinary bladder. Endometriosis in the anterior abdominal wall is also possible and there the implants are usually located in a scar due to previous surgical interventions (C-section, laparoscopy).

- Endometriosis of the ovaries, the Fallopian tubes or the myometrium (adenomyosis) is not considered as deep endometriosis.
In advanced cases of deep pelvic endometriosis not responding to hormone therapy the best treatment is a complete surgical resection of the implants.

**Laparoscopy** is considered the gold standard for the location of peritoneal implants in the pelvis. However, there can be occasionally adherences making difficult to reach the deep and posterior areas of the peritoneal cavity. Moreover, a presurgical assessment of the extent and location of the implants can be very useful as a roadmap to properly program the intervention in order to completely remove the endometriotic implants in various organs and locations.

Endometriosis of the adnexa and the bladder can be correctly evaluated by ultrasound, but the posterior extension, the vaginal and the bowel wall can be difficult to assess by this technique. A pelvic MRI study can give an adequate assessment of the extent of deep pelvic endometriosis, providing an appropriate study design and a careful interpretation of the imaging findings.
Imaging findings OR Procedure details

Magnetic Resonance Technique

MRI studies presented in this poster were acquired on 1.5 T MR magnets, Signa Excite (General Electric Medical Systems). For signal reception an 8 element phased array surface pelvic coil was used.

-Three series of fast spin echo (FSE) T2 weighted images were acquired in sagittal, coronal and axial planes and a FSE T2 fat suppressed series. Acquisition parameters were TR: 3900-4200 ms TE: 85-110 ms, echo train (ETL) 17-21, slice thickness 4-5 mm, gap: 0.5-1 mm, FOV 20-22 cm, matrix 416-320 x 256-224, NEX 4.

-Three T1 weighted series were also obtained in each patient: an axial FSE with similar acquisition parameters to previous, except for TR (500ms) TE (7ms) and ETL (3) and two 3D fast gradient echo fat suppressed T1 weighted sequences (PAVA), acquired in axial and sagittal planes with the following parameters TR 4.6 ms, TE 2.2 ms, slice thickness 3 mm, interpolation x2, matrix 320 x 320, NEX 2.

-When a clinical suspicion of deep pelvic endometriosis on the posterior compartment was suspected, filling of the vagina and rectum was used, to better evaluate these structures. A rectal cleansing enema was previously prescribed and 100-150 mL of diluted ultrasound gel were administered by a rectal cannula and then another 50 mL of sterile ultrasound gel in the vagina. Vaginal gel was administered with the patient lying on a MR table. None of the women referred pain or discomfort during the procedure.

-Intravenous gadolinium contrast was not used as part of the standard study protocol. Enhanced series were only acquired in a few patients trying to better characterize specific findings of the noncontrast studies. No drugs were used to reduce bowel motion.

Radiological findings

-Most of patients with deep pelvic endometriosis also have endometriotic foci in the ovaries, Fallopian tubes or uterine adenomyosis.

Ovarian endometriomas Fig. 1 on page 9 on MR images have usually signs of blood products in different stages, characteristically with high signal intensity in T1 weighted images and signal drop on T2 (T2 shading). Tubal disease Fig. 2 on page 9 usually presents as dilatation and filling of the tube by liquid or hemorrhagic contents. Uterine adenomyosis Fig. 3 on page 10 is characterized on MR by a
marked thickening of the junctional zone (JZ>12 mm) of the myometrium. This area is hypointense on T2 weighted images, but when affected by endometriosis there are often hyperintense glandular foci within the thickened JZ.

-Deep endometriotic foci Fig. 4 on page 11 Fig. 5 on page 12 usually show a different MR imaging appearance. These implants usually manifest as areas with predominantly low signal intensity both on T1 and on T2 weighted MR sequences. They can have a rounded or nodular shape but more often their borders are ill defined, presented as an infiltrative lesion, causing retraction of neighbouring organs or structures. The reason for this is that subperitoneal endometriotic implants produce an important desmoplasic reaction, with fibromuscular proliferation.

-The presence of hemorrhagic foci Fig. 5 on page 12, hyperintense in T1 weighted sequences even after fat suppression is a very characteristic MR finding of endometriotic foci. Nevertheless, this radiologic sign is not as common in deep pelvic implants as it is on adnexal endometriosis.

For this reason, deep endometriosis foci can be difficult to detect and to differentiate from normal hypointense structures in the pelvis (bowel wall, vagina, fascias and ligaments). A careful analysis of the MR images is mandatory, with special attention to areas of thickening, irregularity or retraction in pelvic organs or fascias.

In this sense it is very helpful to distend the vagina and the rectum with gel Fig. 6 on page 13, allowing a better evaluation of these organs that are usually collapsed. Vaginal and rectal walls, vaginal fornices, cervix and Douglas pouch are much better depicted after distension, so we can better assess the morphological alterations, areas of thickening or areas with abnormal signal intensity in these structures.

Specific locations of deep pelvic endometriosis

Deep pelvic endometriosis involves more frequently the posterior compartment of the pelvis. Implants in the Douglas pouch usually produce retraction of the ovaries to the posterior and central part of the pelvis, and there are frequently peritoneal adhesions.

-When the endometriosis progresses deeply in this area, the lesion can infiltrate the posterior vaginal fornix, and then affecting by continuity Fig. 4 on page 11 the uppermost part of the rectovaginal septum Fig. 7 on page 14. Isolated endometriotic implants in the rectovaginal septum, without involvement of the posterior
vaginal recess can also be found, but this type of presentation is much more uncommon (<10%) Fig. 8 on page 15.

-An isolated deep endometriosis implant in the anterior rectal wall, above the peritoneal reflection can also be common. Although in the MR images the location and size of the rectal lesion can be delineated, many times it is not easy to discriminate if it is a superficial Fig. 9 on page 16 or a deep Fig. 10 on page 17 implant.

-Uterosacral ligaments Fig. 11 on page 18 are thin subperitoneal fibrous bands, extending from the lateral sides of the cervix to the anterior part of the sacrum. These ligaments run very closely to the lateral recesses of the vagina and the rectal wall. In normal women these structures are very difficult to identify by MRI. When affected by endometriosis these ligaments can appear thickened and may produce a retraction of the uterus to the more damaged side. Right and left uterosacral ligaments joint in the posterior face of the uterus, in the torus uterinus Fig. 12 on page 19, the area located just above the insertion of the posterior vaginal vault. This is also an area were endometriotic implants are frequently located. Involvement of this area of the uterus can induce a uterine retroflexion.

-An endometrial implant in this posterior uterine region and affecting the uterosacral ligaments, can secondarily affect the bowel wall, usually in the upper third of the rectum or the rectosigmoid area Fig. 9 on page 16.

-Posterolateral extraperitoneal involvement, with secondary damage of the ureter is rare (0.1-1%) and may be due to ovarian endometriosis or to independent peritoneal implants with deep growing in the supberitoneal tissues.

-Deep pelvic endometriosis in the anterior part of the pelvis is more uncommon. The pelvic organ more frequently involved by endometriosis in this compartment is the urinary bladder. Infiltration of the detrusor muscle is usually due to peritoneal implants in the vesico-uterine recess that secondarily grow deep into the bladder wall Fig. 13 on page 20. Clinical symptoms often mimic a cystitis, been hematuria uncommon. On MR images, vesical endometrial implants can simulate a papillary mass growing into the bladder. When hemorrhagic glandular foci are detected into the mass the MR diagnosis is straightforward, otherwise a cystoscopy may be necessary Fig. 14 on page 21.

-Endometriosis of the abdominal wall is uncommon and it is frequently related with previous surgery. Hyperintense foci, specially on T1 weighted images, give an specific diagnosis, differentiating endometriosis from a normal or keloid postoperative scar Fig. 15 on page 22.
Diagnostic difficulties in MRI studies

-Detection of small peritoneal implants is very difficult or even impossible on MRI. Also the detection of adhesions Fig. 16 on page 23 is very limited and we can only assess the displacement of the pelvic organs, deformity of bowel loops and the thickening of walls and fascias. Some authors found cine MRI sequences as useful for the diagnosis of adhesions between bowel loops, although not widely used.

-It is not always easy to clearly define the depth of endometriosis invasion of the bowel wall that can be distorted and retracted even in cases of superficial peritoneal implants, simulating deep endometriotic disease. Fig. 7 on page 14

-There is not consensus regarding the use of IV contrast. Deep endometriotic implants usually enhance after IV Gadolinium contrast. This can facilitate the identification of these lesions in contrast enhanced T1 fat saturated sequences. But there are also many normal structures in the pelvis (walls of organs, vessels, etc) that take also contrast, which can lead to false positive diagnoses.

-Women with endometriosis may also suffer from gynaecological malignancies. The differential diagnosis in MRI can be very difficult. The use of IV contrast can sometimes be useful in these patients.

In our series, the increasing number and size of deep endometriotic foci on MR studies were associated with increasing clinical symptoms despite medical treatment and these women underwent surgical resection more frequently; although this results can be clearly biased because MRI findings were included in the clinical evaluation to decide the surgical approach.

In surgical patients, all deep endometriosis implants detected on MRI were identified at laparoscopic surgery and there, in almost every patient, other foci of superficial peritoneal endometriosis and even small deep implants were also identified. The most common locations of these MRI undetected endometriotic implants were the bowel (sigmoid colon) and the uterosacral ligaments.
Fig. 1: Typical MR characteristics of ovarian endometriomas. They are haemorrhagic cystic lesions, with predominantly high signal intensity on T1 weighted images (A) and variable hypointensity on T2 (B), although typically they lose signal (T2 shading), either diffusely or forming a fluid level (arrows).

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Fig. 2: Hematosalpinx. The dilation of the fallopian tubes containing liquid or, more typically, blood products is also a common finding in women suffering from endometriosis and it may cause infertility. MRI diagnosis is easy when the structure maintains a bended and folded tubular shape, but occasionally dilated tubes can be misdiagnosed as ovarian endometriomas. Coronal T2 weighted (A,B) and axial T1 weighted (C,D) images of a patient with left hematosalpinx and a right ovarian endometrioma (asterisk in D).

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Fig. 3: Myometrial endometriosis (adenomyosis). Sagittal T2 weighted image showing the typical MR signs of adenomyosis in the anterior wall and fundus of the uterus. There is thickening of the miometrial junctional zone (>12 mm) having hyperintense glandular foci within it. This corresponds to hyperplastic smooth muscle due to the ectopic presence of endometrial glandular tissue. Adenomyosis has ill defined limits in contrast with the 5 mm leiomyoma on posterior wall (arrow). There is a previous C-section.

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**Fig. 4:** Frozen pelvis. Patient with bilateral ovarian endometriomas and a frozen pelvis due to a large posterior implant (arrows). This implant was affecting the vaginal vault and continuous involvement through the true rectovaginal septum. It looks infiltrating with nodular areas, with thickening and retraction of vaginal and rectal walls. There are hyperintense foci on fatsat T1 weighted images (A,B) and the implant has mainly low signal on T2(C).

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Fig. 5: Frozen pelvis (cont.): Uterosacral ligaments and torus uterinus are thickened (arrowheads). Axial T2 (D), axial fatsat T1 (E) and coronal T2 (F) images. A complete surgical excision of this large lesion was achieved.

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Fig. 6: Normal postoperative MR study. Sagittal T2 (A,B) and fatsat T1 (C) images in a woman after hysterectomy, anexectomy and upper rectal resection (metallic suture artefact) due to deep pelvic endometriosis. MR study is useful to check the complete removal of deep endometriotic implants and the absence of lesions involving the rectovaginal septum. Filling vagina and rectum allows a better MR evaluation.

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Fig. 7: Deep endometriosis involving rectovaginal septum (arrows). A, B: Axial T2 and T1 FSE images. In this case, small hyperintense foci are detected both on T1 and T2 weighted images. Note the presence of uterine adenomyosis with marked thickening of the JZ of the myometrium, and glandular foci hyperintense on T2 and T1. En bloc resection of the rectovaginal implant was performed and another superficial endometriotic implant was resected on the sigmoid colon. When reviewing MR study the involved area is detected, showing a focal thickening of the sigmoid wall, having the MR aspect of a deep implant.

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Fig. 8: Vaginal wall endometriosis. A, B: Axial T2 and fatsat T1. Small endometriotic hemorrhagic nodule in the posterior vaginal recess, without other clear implants involving the Douglas pouch. C: Sagittal fat suppressed T1 image in other patient with a small nodule in similar location. D: Sagittal fatsat T1 image showing another vaginal hemorrhagic lesion, this time situated in the anterior vaginal wall. All three women were symptomatic.

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Fig. 9: Adnexal endometriosis and rectosigmoid implant (arrow) with aspect of deep infiltration. Rectovaginal septum is normal. At surgery the rectosigmoid implant was detected and resected, although bowel wall infiltration was only superficial. A, B: Sagittal T2 and fatsat T1. C: axial T2.

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Fig. 10: Deep endometriosis of the sigmoid colon. Coronal T2 (A) and fatsat T1 (B) weighted images showing a nodular thickening of the inferior wall of the distal sigmoid colon with some hyperintense areas (arrow). It is consistent with a penetrating endometriotic implant that was surgically resected. Note that bowel filling allows for a better detection of the lesion.

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Fig. 11: Uterosacral ligament. The ovaries are displaced toward the posterior and the center of the pelvis, with endometriomas (partially shown, arrows) and there is thickening and irregularity of the right uterosacral ligament (arrowheads). The rectovaginal septum is normal. FSE T2 (A and B) and T1 fat saturation (C).

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Fig. 12: Uterosacral ligaments. A. There is thickening of the right uterosacral ligament (arrowheads) and the uterine torus, both involved by deep endometriosis, surgically confirmed. B and C: Axial T2 and fatsat T1 in another case with thickening of the left uterosacral ligament (arrowheads) and signs of uterine adenomyosis (partially shown). This woman has not been operated.

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Fig. 13: Deep bladder endometriosis. Sagittal T2-weighted image (A) in which there is a marked thickening of the roof of the bladder, reaching the posterior wall. The lesion's inner surface looks hairy or papillary (arrow) with low signal intensity and having hyperintense foci within it. Also on the T1-weighted image with fat suppression (B) the lesion has some hyperintense foci, hemorrhagic (arrow), characteristic of endometriosis. Note the thickening and growing of hypointense tissue in T2 occupying the vesicouterine recess, corresponding to an implant of endometriosis in this peritoneal pouch.

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Fig. 14: Bladder endometriotic nodule in another patient, in this case it is located on the anterior and right side of the bladder roof.

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Fig. 15: Endometriosis of the abdominal wall. Sagittal fatsat T1 (A), axial T2 (B) and sagittal fatsat T2 (C) MR images showing an endometriotic implant in the rectus abdominis muscle of a patient with a previous Cesarean section. Hyperintense hemorrhagic foci (arrow) and T2 hypointense fibrotic areas are clearly depicted.

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Fig. 16: Adhesion fibrous band connecting an endometriotic implant on the Douglas pouch and the rectosigmoid wall. Note the anomalous uterine position, clearly lateralized to the right side.

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Fig. 17: Endometriosis and tumor. Axial T2 (A) and fatsat T1 (B) images of a patient with bilateral ovarian endometriosis and deep implants in the uterine torus region (arrowheads). There is an endometriotic tract that reaches the anterior wall of the rectum (arrow). She also had involvement of the left uterosacral ligament and the left side of the vaginal vault, with deep infiltration getting through the left ureter. The changes in the morphology and signal of the cervix on MRI (C, D: T2 axial and coronal images) were reported as suspicious for a cervical neoplasia that was not clinically suspected. The surgery confirmed the presence of a cervical carcinoma and also deep endometriosis in this area.

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**Fig. 18:** Endometriosis and tumor: Using IV Gadolinium contrast can be helpful to detect solid ovarian lesions (arrowheads) associated to endometriotic hemorrhagic cysts, as in this case. A,B: Axial T1 and T2 weighted FSE images. Gradient echo fat supressed T1 weighted images before (C) and after gadolinium injection and image subtraction (E: D minus C).

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Conclusion

MRI is a useful technique for the diagnosis of deep endometriosis in the pelvis. Detecting the location and extent of deep endometriotic implants can be of value to decide the therapeutic approach and serve as a guide for laparoscopic surgery. MRI can also have a role in postsurgical evaluation of complex cases.

An appropriate MR study protocol is required for a correct assessment of the lesions. Vaginal and rectal distension, using fluid or gel, facilitates the detection of deep endometriotic implants in the posterior compartment of the pelvis. A detailed knowledge of the MR anatomy and the characteristic findings of the disease are also necessary for a correct analysis of the studies.
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