Deep Endometriosis: Don’t Forget about Round Ligaments. MRI Features, Clinical and Anatomic Review.

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Learning objectives

To help Radiologists in correctly identifying round ligament endometriosis on magnetic resonance images (MRI)
Background

Endometriosis is the presence of functional endometrial glands and stroma outside the uterine cavity and affects approximately 10 to 20% of reproductive-age women.

The patients may have a variety of symptoms such as progressive dysmenorrhea, menstrual irregularities, dyspareunia and infertility.

Deep infiltrating endometriosis (DIE) is hystologically defined as a lesion that extends more than 5 mm into the subperitoneal space and/or that affects wall of pelvic organs and ligaments. \(^1\)

DIE predominantly affects posterior structures such as rectovaginal septum and uterosacral ligaments (69.2%), wall of the vagina (14.5%) and the bowel (9.9%). \(^2\)

Anterior locations of DIE are less frequent and affect the urinary tract, the round ligament and the canal of Nuck.

Endometriosis of the round ligaments of the uterus (RLU) is a rare localization (about 0.3 to 0.6% of the patients affected by endometriosis). Such location is often unknown to clinicians and radiologists. This is mainly due to non-specific symptoms, which often lead to misdiagnosis and make the surgery incomplete from the perspective of achieving complete excision. \(^1\)

The knowledge of pelvic anatomy and possibility of atypical pelvic localization of DIE as RLU might help the radiologists to focus on that site and to make a correct diagnosis.
 Imaging findings OR Procedure details

Embriology

RLU derive from the lower part of the female Gubernaculum, an embryonic structure, where the upper part becomes the ovarian ligament.

The Gubernaculum forms from the caudal fold and is provoked by the mesonephros elevating to covering the peritoneum. It begins as a cord that extends from the gonadal ridge, the location of undifferentiated gonad, to the future inguinal region. It is composed of coelomic-epithelium covered by mesenchimal, muscular and extracellular matrix precursor cells. It persist as the RLU which penetrates the abdominal wall together with the processus vaginales peritonei and always remains fixed distally at the pubic region. [3]

Fig. 1 on page 8

Anatomy

RLU are bilateral structures arising from the uterine horns, where the uterus and the uterine tube meet. They course from the uterus through the broad ligament, internally and ahead the external iliac vessels, running along the pelvic sidewall and leaving the abdomen through the internal ring. They run into the inguinal canal, side by side to round ligament artery, external iliac vein and ilio-inguinal nerve, and finally they insert in labia majora. [4]

Fig. 2 on page 8
Fig. 3 on page 9

From their anatomical course, RLU result to have an intra-peritoneal and an extra-peritoneal portion.

There are various references to endometriosis of the RLU, most of them referring to the extra-peritoneal portion in the context of surgical treatment with radical excision. However, there are few reports about the localization of endometriosis in the intra-pelvic portion of the RLU.

Ligaments length is approximately 10-12 cm; they contain vessels (veins and arteries branches of the ovarian artery), lymphatics, smooth muscle and nerves.
The Function of the RLU is to maintain the antversion of the uterus. [4]

Fig. 4 on page 10

**Etiopathogenesis**

The etiopathogenesis of RLU endometriosis is still uncertain and probably multifactorial:

- Metastatic implantation of endometrial tissue by retrograde menstruation, bloodstream or lymphatic channel.
- Metaplastic differentiation of coelomic epithelium or the remnants of mullerian tissue.
- The endometrium-release of substances inducing undifferentiated mesenchyme to form endometriotic tissue (Induction theory). [2]

**Clinical presentation**

Endometriosis of the RLU might have unusual symptoms. Pain can be localized in the lower abdomen, in the groin, in the lumbar region, as well as in the anterior region of the thigh with cyclical exacerbation.

The disease may also arise with painful tumefaction, non-compressible and non-reducible swelling associated with stiffness of soft tissues in the inguinal canal. [5]

In literature, most of the authors describe a prevalence of endometriotic lesions in the right side. Various theories help to explain this preference: the presence of clockwise introperitoneal fluid circulation from the left peritoneal gutter across the pelvic floor, or the right diaphragm and the liver capsule, due to the intestinal peristalsis and the respiratory movement. Endometrial cells tend to stay in the right side mainly due to the fact that the gravity before fluid moves to the right peritoneal gutter; the sigmoid colon could provide a form of barrier to the menstrual flow reflux on the left side. [6]

In the majority of the cases, the patients with RLU involvement have concomitant endometriosis of the posterior pelvic compartment.

**MRI features**

On MRI the RLU can be identified as a thin structure with fibrous signal running from the uterine horns to the pelvic sidewall and passing anterior to the external iliac vessels. [1]
Endometriosis of RLU can be detected from alterations of morphology and signal.

Involvement of RLU by endometriosis is morphologically characterized by a thickened, shortened and deviated aspect of the ligaments.

Ligaments with an increased diameter (more than 1 cm) were considered to be thickened. Laterally diminished ligaments might be considered shortened.

RLU with a trajectory altered in any direction might be considered deviated.

The ligaments could be irregular, occasionally with nodular appearance. \[1\] [7]

The signal intensity of the ligaments may vary depending on the presence of stromal tissue, glandular elements, hemorrhage, inflammatory reaction or fibrous tissue.

Pure fibrous lesions are hypointense on T1w and T2w images, whereas glandular lesions are hyperintense on both T1w and T2w images. The most frequent lesions mix these two components and contain fibrous tissue with hyposignal on T1w and small hemorrhagic foci that show hyperintensity on T1w. \[1\]

Fig. 5 on page 11

Fig. 6 on page 12

Fig. 7 on page 13

The absence of the hyperintense hemorrhagic foci might be due to hormonal treatment too. \[8\]

Fig. 8 on page 13

Fig. 9 on page 14

In our experience, the detection of free fluid around the RLU on "anti-declive position" might be an indirect sign of the endometriosis involvement of the intraperitoneal portion of the ligaments.

Fig. 10 on page 15

The feature of the disease described above imply that in the study protocol some sequences are necessary to increase the sensitivity of MRI:
T2w images without fat suppression are important for a good visualization of the pelvic structures and the abdominal wall.

T1w images with fat suppression emphasize hemorrhagic lesions relative to the fatty background because of their spontaneous hyperintensity compared to the muscles; this sequence is the most sensitive in detecting lesions smaller than 1 cm. \[1\][4]

An alternative diagnosis might be vascular congestion and areas of hemorrhage, suggesting the inflammation of the structure and demonstrating the macroscopic alteration. \[7\]

Treatment of endometriosis localization of RUL could be pharmacological or surgical and consists in the complete excision of the affected ligaments. Surgical resection has been associated with significant improvements in the life quality up to 80% of the patients over a 5-year follow-up period. \[7\]
**Fig. 1:** Schematic illustration of the possible development of the gubernaculum in female; modified from: Acién P, Sánchez del Campo F, Mayol MJ, Acién M. (2011) "The female gubernaculum: role in the embryology and development of the genital tract and in the possible genesis of malformations" Eur J Obstet Gynecol Reprod Biol Dec;159(2):426-32.

Fig. 2: Schematic view of female pelvis; modified from Agur Anne M.R, Dalley Arthur F."Grant's atlas of human anatomy"(2009) 12th edition,

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Fig. 3: Normal anatomy of round ligaments: View of pelvic structures extended by ascitis on axial T2w and axial T1w contrast enhanced images.

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Fig. 4: Course of the RLU in axial T2 w images from cranial to caudal planes in a patient with bilateral endometriomas (kissing ovaries). Red lines: intraperitoneal part of RLU; pink lines: extra-peritoneal part of RLU; B, bladder; R, rectum; U, uterus; V, external iliac vessels; O, ovary; E, inferior epigastric vessels. Fig. A) Intra-peritoneal portion at the origin from the uterine horns; fig. B) intra-peritoneal portion ahead and internally the external iliac vessels; fig C) extra-peritoneal portion of RLU into the upper portion of the inguinal canal.

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Fig. 5: Typical localization of endometriosis of RLU intra-peritoneal portion in a young woman: thickened and shortened bilateral RLU with fluid in front of the left one (orange arrow). On T2W axial and coronal image (fig a, b) hypointense signal of the RLU; on axial T1 fat-sat image (fig c) absence of hyperintense foci. On axial T2w image (fig d) extra-peritoneal portion of the RLU is normal. MRI examination was performed with gel on rectum.

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**Fig. 6:** Localization of endometriosis of the intra-peritoneal proximal portion of the left RLU in a young woman: axial T2w image shows (fig. A) thickened and shortened aspect of the ligament with lateral deviation of the uterus (U); axial T1w fat-sat image shows a small hyperintense hemorrhagic foci (fig. B).

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**Fig. 7:** Localization of endometriosis of the intra-peritoneal proximal portion of the right RLU in a young woman: on axial and coronal T2w images (fig. A and C) and axial T1w fat-sat image (fig. B) thickened, shortened and deviated aspect of the ligament without hemorrhagic foci; uterus (U) attracted on the right.

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Fig. 8: Right RLU localization of endometriosis in a young woman with signs of diffuse pelvic endometriosis: MRI evaluation before and after 2 years of medical therapy. Fig. A, B and C, before therapy: shortened and deviated aspect of right RLU with thickened and nodular appearance; the ligament shows hypointensity on axial and coronal T2w images (Fig. A, C) because of the presence of fibrous tissue with evidence of small hemorrhagic foci on axial T1w image (fig. B). Fig. D, E and F, after 2 years of hormonal treatment: thickness reduction on axial and coronal T2w images (Fig D, F) and increased hypointensity of the lesion; on axial T1 fat-sat image (Fig. E) there is no evidence of the hyperintense hemorrhagic foci previously present.

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**Fig. 9:** Endometriosis of the extraperitoneal portion of the right RLU in the same patient of figure 9 before the therapy. On axial T2w images the hypointense plaque is adherent to the abdominal wall (fig. A), with small hemorrhagic foci on axial T1w image (fig. B); the symptoms reported by the patient were groin and thigh pain.

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**Fig. 10:** Localization of endometriosis of the intra-peritoneal proximal portion of the left RLU in a young woman: on T2w axial images free fluid (arrow) on "anti-decline position" around the thickened and shortened RLU .

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Conclusion

Endometriosis of the RLU is a rare localization to be considered in female patients with suspected pelvic endometriosis. The knowledge of anatomic details of these ligaments might help radiologists to better recognize and define the pelvic extension of the disease in order to help gynecologists for the patient's work up.
References


[5] Silberman EA; Quildrian SD; Vigovich FA; Porto EA, Inguinal endometriosis of the round ligament- Endometriosis del ligamento redondo inguinal, Cir Esp. 2011;89;469-70.


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