MRI in deep endometriosis: can we reduce undertreatment?

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Aims and objectives

Endometriosis consists of the presence of endometrial glands and stroma outside of the uterine cavity (1), that is in the adnexa (tubo-ovarian endometriosis), or in the torus uterinus, recto-vaginal septum, utero-sacral ligament, pelvic wall or pelvic organs (deep endometriosis).

Endometriosis is a disease involving 10% of patients (2), with a peak of incidence in childbearing age between 24 and 29 years, and causing chronic and invalidating pelvic pain in more than half of histologically confirmed cases (3) and infertility being present in 30% of infertile women (4).

This is due to irreversible anatomic and functional alterations of tubo-ovaric structures (5) induced by chronic inflammation resulting by repeated bleedings of endometriotic lesions.

The onset of these alterations are favoured by a late diagnosis, especially in the cases of deep endometriosis. In fact clinical examination has been demonstrated to have a sensitivity of 33,3-35,3% for deep endometriosis (6), whereas trans-vaginal ultrasound showed a sensitivity of 88,2% for adnexa but of only 57% for torus uterinus, of 63% for uterosacral ligaments, of 63.2% for rectovaginal septum and of 73.7% for rectosigmoid junction, (7) giving false negative results in the detection of deep endometriotic lesions.

So when ovarian endometriosis is not associated with deep endometriosis Patients are at risk of being misdiagnosed and undertreated.

When tubo-ovarian endometriosis is associated with deep endometriosis Patients who receive diagnosis of ovarian endometriosis undergo anyway to laparascopy, but the presence of adhesions can limit the visualization of deep endometriotic implants by the surgeon and surgical treatment can be not resolutive. So also in these cases it's important to detect deep endometriosis for a correct surgical planning.

The aim of this study is to determine if MRI can identify deep endometriosis by comparison with histology to avoid false negative results in Patients with deep endometriosis not associated with ovarian endometriosis, and to tailor a most appropriate surgical treatment in Patients with deep endometriosis associated with ovarian endometriosis.
Methods and materials

This retrospective study enrolled all Patients between December 2009 and April 2012 with suspected tubo-ovarian and/or deep endometriosis, whose data were considered for inclusion in our study. Patient data were included according to the following criteria: Patients with (a) tubo-ovarian and/or deep endometriosis suspected at physical examination and transvaginal ultrasound, (b) availability of MR examination findings, (c) histopathological results from laparoscopic or surgical treatment.

Exclusion criteria were as follows: (a) There was a lack of available MR examination findings, and/or (b) There was a lack of a definitive histopathological results.

Thus, the final study population comprised 49 Patients with a mean age of 36 years (age range, 20.3 - 47.6 years).

We considered as gold standard hystological findings from bioptical specimens obtained during laparoscopic or laparotomic treatment.

MR Imaging
MR imaging was performed with a 1.5-T MR unit (Magnetom Symphony; Siemens, Erlangen, Germany) by using a phased array coil.

Before the examination we subministrated to all Patients 1 mg of butylscopolamine intramuscularly (Buscopan, Schering, Germany) to minimize movement artefacts due to bowel peristalsis and performed retrograde injection of gel through the rectum to improve the visualization of near pelvic structures.

Then we acquired T2 Turbo-Spin-Echo sequences on axial (TR 3651,9; TE 100), choronal (TR 4251,1; TE 100) and sagittal plane (TR 3857,4; TE 100), T1 Turbo-Spin-Echo sequence on axial plane (TR 642,3; TE 10) and T1 fat sat sequence (TR 5,8; TE 2,8).

Image Analysis
The MR images were independently analyzed at a workstation by two radiologists (R.M., V.D.P., 20 and 4 years experience in abdominal radiology, respectively) who were aware of the diagnosis of endometriosis.

The analysis of imaging comprised the signal intensity characteristics, the site and the dimensions of deep endometriotic lesions.

We considered as pathologic a hyperintense signal intensity on T1-weighted imaging with and without fat-suppression or a hypo-isointense signal intensity on T1- and T2-weighted imaging, in respect of signal intensity of muscles.

For all signal intensity anomalies so detected we assess them a score according to revised ENZIAN score of 2010 (FIG. 1), which has been demonstrated an excellent score for morphological description of deep endometriosis (8-9).

We considered lesions located in rectovaginal or rectouterine septum as 1A if < 1cm, 2A if between 2 and 3 cm and 3A if > 3 cm (FIG. 2); lesions on uterosacral ligaments as 1B if < 1cm, 2B if between 2 and 3 cm and 3B if > 3 cm (FIG. 3), lesions on rectal or colic wall as 1C if < 1cm, 2C if between 2 and 3 cm and 3C if > 3 cm (FIG. 4). Then we
consider eventual presence of uterine adenomyosis (that is the thickness of myometrium-endometrium junction line more than 12 mm) as FA (FIG. 5), of bladder lesions as FB (FIG. 6), of ureteral lesions as FU, of sigma, coecum and ileum lesions as FI and other lesions as FO.

**Statistical Analysis**

We calculated ENZIAN score both for MRI findings and hystopathological results. By comparing MRI-ENZIAN score and hystopathological-ENZIAN, which represented our Gold Standard, we calculated the sensitivity, specificity, accuracy, positive and negative predictive values for ENZIAN parameters all together and for each one.

Then we divided Patients in two groups on the basis of the presence of only deep endometriosis (A-Group) or of the presence of both tubo-ovarian and deep endometriosis (B-Group) to determine in each group the sensitivity, specificity, accuracy, positive and negative predictive values for ENZIAN parameter all together and for each one.
Results

At MRI we didn't find any endometriosic lesions in 17/64 Patients (0 accordingly ENZIAN Score). In the other 47/64 Patients we found: 42 lesions in rectovaginal space of which 11 < 1 cm (1A), 17 between 2 and 3 cm (2A) and 14 > 3 cm (3A); 21 lesions on uterosacral ligaments, of which 12 < 1 cm (1B) and 9 between 2 and 3 cm (2B); 12 lesions on rectal or colic wall, of which 7 < 1cm (1C), 4 between 2 and 3 cm (2C) and 1 > 3 cm (3C). In 3 cases we found uterine adenomyosis (FA).

At hystopathological analysis we didn't find any endometriosic lesions in 15/64 Patients (0). In the other 49/64 Patients we found: 43 lesions in rectovaginal space of which 10 < 1 cm (1A), 15 between 2 and 3 cm (2A) and 18 > 3 cm (3A); 21 lesions on uterosacral ligaments, of which 12 < 1 cm (1B) and 8 between 2 and 3 cm (2B) and 1 > 3cm (3B); 12 lesions on rectal or colic wall, of which 7 < 1cm (1C), 4 between 2 and 3 cm (2C) and 1 > 3 cm (3C). In 3 cases we found uterine adenomyosis (FA) and in 5 cases we found lesions on bladder wall (FB).

By comparing the MR imaging findings and pathologic findings, MR imaging reported a sensitivity of 89% a specificity of 99% and an accuracy of 98% (PPV of 96% and NPV of 98%).

For each parameter the value of sensitivity, specificity and accuracy was respectively of: 100%, 96% and 97% for 0-parameter (PPV of 88% and NPV of 100%), 91%, 98% and 96% for A-parameter (PPV of 93% and NPV of 97%); 95%, 99% and 99% for B-parameter (PPV of 95% and NPV of 99%); 100%, 100% and 100% for both C- and FA-parameter (PPV and NPV of 100%), 50% 100% 93% for FB-parameter (PPV of 100% and NPV of 92%).

On the basis of these hystopathological findings we divided Patients in three groups: Patients with only deep endometriosis, Patients with both tubo-ovarian and deep endometriosis and Patients with only tubo-ovarian endometriosis which resulted so respectively composed: 13/64 (20,3%), 34/64 (53,1%) and 17/64 (26,6%) Patients.

We made a further analysis for the two groups with only deep endometriosis and with both tubo-ovarian and deep endometriosis:

• **Group with only deep endometriosis (A-Group)**

MRI

In rectovaginal space we found 1 lesion < 1 cm (1A), 4 lesions between 2 and 3 cm (2A) and other 4 lesions > 3 cm (3A); on uterosacral ligaments we found 3 lesions < 1 cm (1B), 4 lesions between 2 and 3 cm (2B) and 1 lesion > 3 cm (3B); on rectal or colic wall
we found 1 lesion < 1 cm (1C) and 2 lesions between 2 and 3 cm (2C); in two cases we found uterine adenomyosis (FA).

**Hystopathology**

In rectovaginal space we found 4 lesions between 2 and 3 cm (2A) and 5 lesions > 3 cm (3A); on uterosacral ligaments we found 3 lesions < 1 cm (1B), 4 lesions between 2 and 3 cm (2B) and 1 lesion > 3 cm (3B); on rectal or colic wall we found 1 lesion < 1 cm (1C) and 2 lesions between 2 and 3 cm (2C); in two cases we found uterine adenomyosis (FA).

By comparing the MR imaging findings and pathologic findings, MR imaging reported a sensitivity of 96% a specificity of 100% and an accuracy of 100% (PPV of 96% and NPV of 100%).

For each parameter the value of sensitivity, specificity and accuracy was respectively of: 90%, 99% and 99% for A-parameter (PPV of 90% and NPV of 99%), 100%, 100% and 100% B-, C-, FA-, FB-parameter (PPV of 100% and NPV of 100).

- **Group with both deep and tubo-ovarian endometriosis (B-Group)**

**MRI**

In rectovaginal space we found 10 lesions < 1 cm (1A), 13 lesions between 2 and 3 cm (2A) and 10 lesions > 3 cm (3A); on uterosacral ligaments we found 9 lesions < 1 cm (1B) and 4 lesions between 2 and 3 cm (2B); on rectal or colic wall we found 6 lesions < 1 cm (1C), 2 lesions between 2 and 3 cm (2C) and 1 lesion > 3 cm (3C); in one case we found uterine adenomyosis (FA).

**Hystopathology**

In rectovaginal space we found 10 lesions < 1 cm (1A), 11 lesions between 2 and 3 cm (2A) and 13 lesions > 3 cm (3A); on uterosacral ligaments we found 9 lesions < 1 cm (1B) and 4 lesions between 2 and 3 cm (2B); on rectal or colic wall we found 6 lesions < 1 cm (1C), 2 lesions between 2 and 3 cm (2C) and 1 lesion > 3 cm (3C); in 5 cases we found endometriosic lesions of the bladder and in one case we found uterine adenomyosis (FA).

By comparing the MR imaging findings and pathologic findings, MR imaging reported a sensitivity of 89% a specificity of 90% and an accuracy of 99% (PPV of 97% and NPV of 99%).

For each parameter the value of sensitivity, specificity and accuracy was respectively of: 92%, 98% and 97% for A-parameter (PPV of 94% and NPV of 97%); 100%, 100% and 100% for B-, C- and FA-parameter (PPV of 100% and NPV of 100%); 50%, 100% and 93% for FB-parameter (PPV of 100% and NPV of 92%).
Conclusion

MRI has been demonstrated to have an accuracy of 98% for deep endometriosis, in accordance with recent literature results (10-12).

In our work we found the highest accuracy for rectal-colic wall and for uterosacral ligaments, resulting higher than other works (13-14) probably due to the retrograde injection of gel through the rectum (15).

The main limit was represented by bladder lesions, probably due to fibrotic constitution of the lesions (16) and to poor filling of the bladder.

On conclusion, MRI has been demonstrated useful in pre-surgical planning as already demonstrated by other works (17-20). In particular in our experience, MRI has been able to minimize false negative results in Patients with deep endometriosis not associated with ovarian endometriosis, and to tailor a most appropriate surgical treatment in Patients with deep endometriosis associated with ovarian endometriosis.

In fact all 14/14 (100%) Patients with only deep endometriosis received correct diagnosis, avoiding false negative results and undertreatment.

Of 35 Patients with both deep and tubo-ovarian endometriosis 27/35 (82,8%) Patients underwent to surgery with a correct preoperative staging (with a dimensional mistake only in 2 cases); only in 6/35 (17,8%) Patients the lesions were completely misdiagnosed, but they were anyway found at explorative laparoscopy to which Patients were envoyed on the basis of MRI results.
References


