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Original Research Article

Decoding the role of MRI in evaluation of endometriosis and its mimics

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ABSTRACT

Background: Endometriosis is presence of endometrial tissue at a site outside the uterus. Endometriosis is a common and important entity affecting women of reproductive age group. Diagnosis of endometriosis is a combination of clinical history combined with non-invasive and invasive imaging. Its differentiation with other mimicking pathologies becomes crucial in proper diagnosis and management of the patients with overlapping symptoms. Aim was to assess the role of MRI in characterising endometriosis and differentiating it from its various mimics.
Methods: The study was performed on 30 patients with complaints of pelvic pain, dysmenorrhea and patients suspected of endometriosis in Dr. Ram Manohar Lohia Hospital, New Delhi from January 2022 to January 2023 under ultrasound and MRI SEIMENS 3T machine. Radiological characteristics were studied and evaluated. Descriptive and inferential statistical analysis was made.
Results: Wide spectrum of cases were studied and characteristic imaging features of each mimic was evaluated.
Conclusions: MRI is sensitive in detecting endometriosis and differentiating it from its various mimics. MRI being non-invasive can be easily done and therefore plays a crucial role in making correct diagnosis combined with clinical history.

Keywords: Endometriosis, Laparoscopy, MRI

INTRODUCTION

Endometriosis is presence of endometrial tissue at a site outside the uterus.[1] Endometriosis is a common and important entity affecting women of reproductive age group. The etiology of endometriosis is multifactorial and includes many complex pathogenesis theories.[1]

Prevalence of endometriosis ranges from 10% in reproductive age group women and 20-50% in women with infertility and almost 90% in women with chronic pelvic pain.[2]

Diagnosis of endometriosis is a combination of clinical history combined with non-invasive and invasive imaging.[3]

Endometriosis is of 3 forms: superficial peritoneal lesions, ovarian endometriomas, and deep (solid infiltrating) endometriosis. (at least 5 mm of invasion into the peritoneal surface).[4]

Characteristic imaging features of endometriosis consists of high T1 weighted signal intensity with a lower T2 signal intensity (as compared with functional or simple ovarian cyst)- T2 shading, bilaterality and multifocality. They can show loss of signal intensity on STIR images and can show DWI restriction with corresponding low ADC values (T2 blackout effect).[5] Presence of a T1 weighted hyperintensity in a dilated fallopian tube is specific for endometriosis (doesn't show T2 shading). Deep infiltrating endometriosis appears as T2 low signal

intensity areas in the peritoneal surfaces (rectouterine pouch- most common location).[6]

MRI plays a very crucial and pivotal role in distinguishing endometriosis from various other pathologies by the help of its multiplanar capabilities, excellent soft tissue resolution and multiple basic as well as advanced sequences.[7] However, laparoscopy is the gold standard for diagnosis of endometriosis.[8] One-step surgery (i.e., diagnosis and complete excision of the lesions at the same time) is very crucial for the successful treatment of endometriosis and, therefore, presurgical mapping of the endometriotic lesions becomes important.[9]

Differentiation of endometriosis from its mimics is important because majority of them will present with similar clinical presentation- dysmenorrhea, pelvic pain. Endometriosis is one of the only benign conditions that can cause elevated CA-125 levels.[10] Imaging appearance on Ultrasound is non-specific for various pathologies and can create a sense of confusion and false negative and positive findings while reporting. Thus, its differentiation from other mimicking pathologies becomes crucial in proper diagnosis and management of the patients.[11]

Important pathologies that can mimic endometriosis are: hemorrhagic cyst, teratoma, tubo ovarian abscess/ hydrosalpinx, malignant ovarian masses, and focal adenomyosis.

METHODS

The present cross sectional observational study was performed in Dr. Ram Manohar Lohia Hospital from January 2022 to January 2023 on 30 patients with complaints of pelvic pain, dysmenorrhea and patients suspected of endometriosis. Abdominal ultrasound scans and contrast enhanced MRI (SEIMENS 3T MRI machine) was performed to evaluate the role of MRI in differentiating endometriosis from its various mimics.

Methodology

The study was performed on 3 Tesla Skyra MRI scanner after taking written or informed consent, using following protocol and sequences- T1, T2 axial and sagittal sequence, T2 coronal, T1 FAT SAT, TIRM, hemo sequence, T1 post GAD vibe sequence, DW-MRI and dynamic contrast kinetic sequence (optional). Histopathological correlation was done in all patients.

Statistical analysis

Correlation of ultrasound, MRI findings and histopathological findings was done and it was found that sensitivity of MRI in diagnosing endometriosis was 92.3% and in diagnosing haemorrhagic cyst was 94.2%. Strength of association between ultrasound and histopathological findings was found to be moderate (Cramer's V=0.49). For MRI the strength of association with histopathological findings was high (Cramer' V=0.71).

The overall diagnostic accuracy for ultrasound in evaluation of endometriosis and differentiating it from its mimics was 76% and for MRI was 89%.

RESULTS

Our study comprised of 30 patients. The mean age of our study population was 29.5 years. The median for our study population was 27 years. The age of patients ranged from 15 to 60 years.

Out of 30 patients, 22 presented with complaints of dysmenorrhea with irregular menstrual cycles, 5 with symptoms of acute abdominal pain and 3 with abnormal uterine bleeding.

Out of 30 patients, site of origin of lesions were ovarian in 22 patients, adnexal in 5 patients and uterus in 3 patients.

On ultrasound evaluation, 7 lesions appeared as hypoechoic with internal reticular echoes, 9 as hypoechoic with low level ground glass echoes, 3 as thick-walled hypoechoic lesion with internal debris, 5 as hyperechoic and 6 as solid cystic lesion with heterogenicity.

On MRI correlation, in T1 weighted images, 18 lesions showed hyperintense signal intensity and 12 showed iso to hypointense signal intensity.

On T2 weighted imaging, 8 lesions show low signal intensity or shading, 9 showed fluid-fluid level, 2 showed hyperintense signal intensity with suppression on TIRM and 7 showed hyperintense signal intensity without suppression on TIRM.

On evaluation with DWI and ADC maps, 16 showed diffusion restriction with low ADC maps and 14 showed no restriction.

On post gadolinium enhancement, 7 patients showed peripheral rim enhancement and 8 showed enhancement in solid component.

Table 1: Distribution of study population based on the appearance of lesions on ultrasound.

Lesions	Number
Hypoechoic with internal reticular echoes	7
Hypoechoic with low level ground glass echoes	9
Thick-walled hypoechoic lesion with internal debris	3
Hyperechoic	5
Solid cystic lesion with heterogenicity	6

Table 2: Distribution of study population based on the T2 weighted image.

Appearance on T2 weighted image	Number of patients
Low signal intensity or shading	8
Fluid-fluid level	9
Hyperintense signal intensity with suppression on TIRM	2
Hyperintense signal intensity without suppression on TIRM	7

Of the 30 patients evaluated by USG and MRI, diagnosis made on imaging was correlated with clinical/ surgical/histopathological evaluation and it was found that (incomplete).

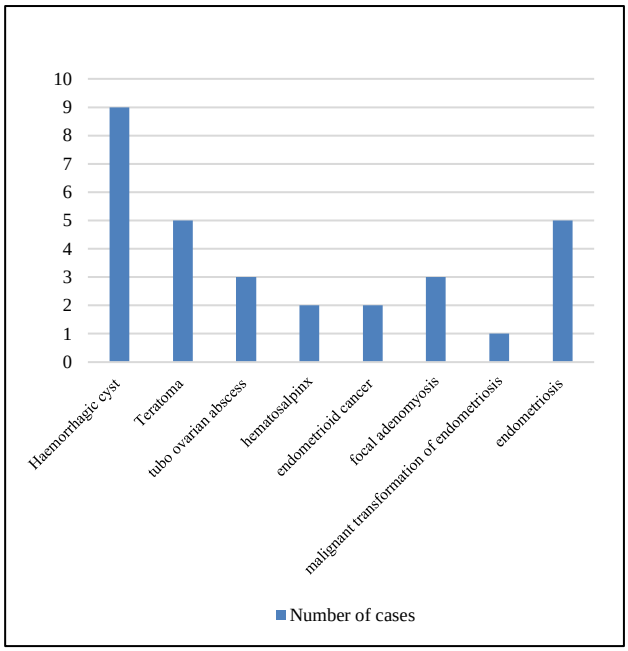


Figure 1: Number of cases.

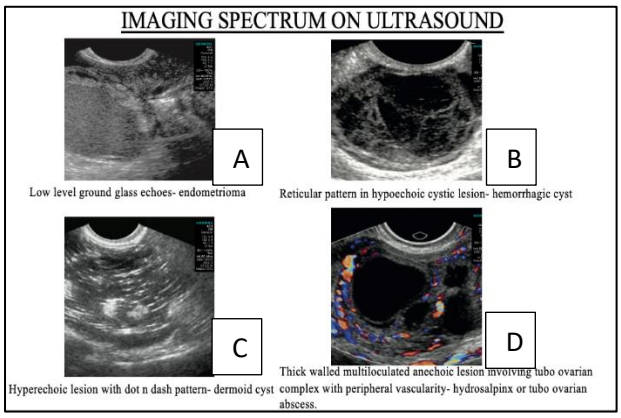
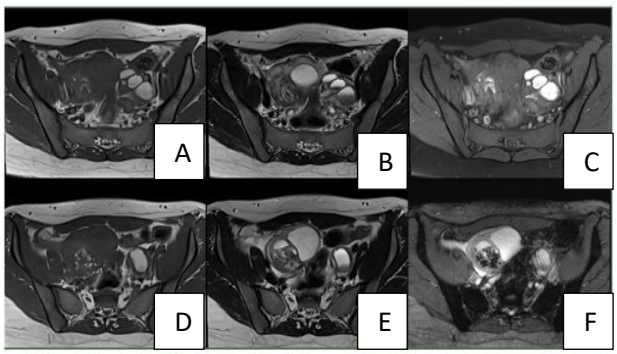
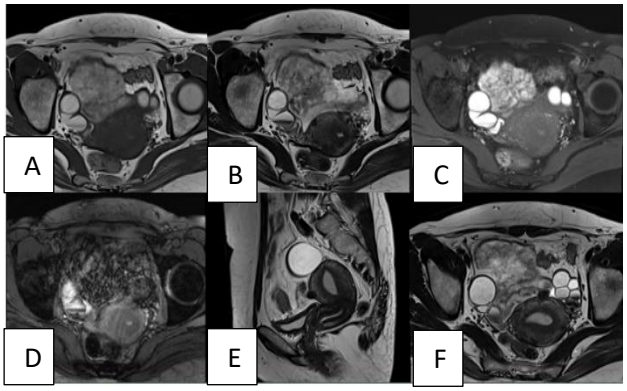


Figure 2 (A-D): Imaging spectrum on ultrasound.



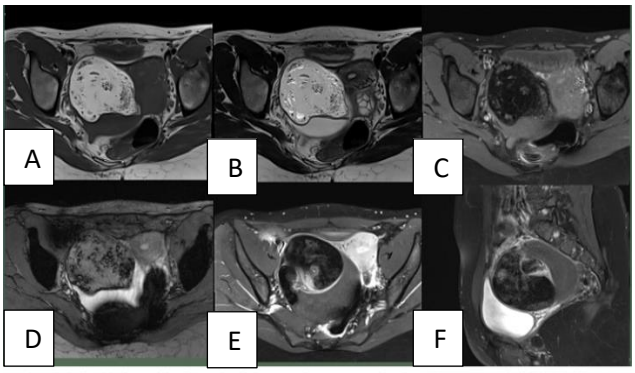
Bilateral ovaries appear bulky with multiple internal small well-defined areas of hyperintensity on T1W and T1FS images with corresponding hypointensity on T2WI (T2 shading), blooming on gradient images- bilateral Endometrioma.

Figure 3 (A-F): Diagnosis of a 27-year-old female with pelvic pain and irregular menstrual cycle.



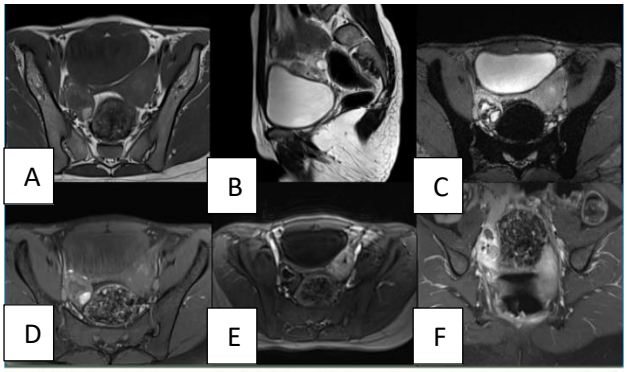
The uterus appears mildly bulky and shows few T1/ T2 hypointense ill marginated areas along sub-serosal aspect of uterus anteriorly s/o endometriosis. Convoluted tubular structures with incomplete septations seen in right adnexa with T1 hyperintense contents and T2 shading, areas of blooming on GRE sequence s/o dilated fallopian tubes with hemorrhagic contents within- Hematosalpinx due to serosal Endometriosis.

Figure 4 (A-F): 45-year-old female with history of abnormal uterine bleeding.



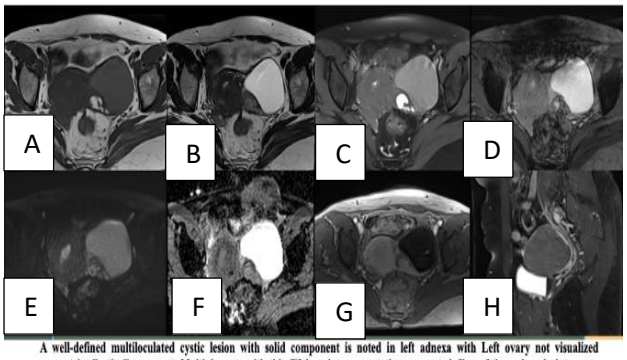
A well-defined lesion arising from the right ovary is seen appearing hyperintense on T1 & T2WI with suppression on STIR images s/o fat component.
Few loculi appear hypointense on T1 and hyperintense on T2/STIR s/o fluid component. Eccentrically located solid component shows post contrast enhancement. –Teratoma.

Figure 5 (A-F): 23-year-old female with complaint of pelvic pain and irregular menstrual cycle.



A well-defined cystic lesion measuring 2x1.6x1 cm (CCxTRAxAP), appearing hyperintense on T1 and T2/TIRM images, showing few blooming foci on hemo sequence and slight rim enhancement on post contrast study is noted in the right ovary; s/o hemorrhagic cyst.

Figure 6 (A-F): 20-year-old female with history of acute pelvic pain.



A well-defined multiloculated cystic lesion with solid component is noted in left adnexa with Left ovary not visualized separately. Cystic Component- Multiple cysts with thin T2 hypointense septations are noted. Few of these show isointense to hyperintense signal on T1WI and hyperintense signal with shading on T2WI, likely mucinous content. Few of the cysts are showing marked hyperintense signal on T1WI and blooming on hemo sequences s/o subacute hemorrhage. On post contrast images, enhancement of septae is noted. No e/o diffusion restriction
Enhancing solid component is noted in posteromedial aspect of the lesion, showing hypointense signal on T1WI, mild hyperintense signal on T2WI. – Endometrioid carcinoma of the ovary.

Figure 7 (A-H): 48-year-old female patient presented with increase in pelvic pain.

Subsequent studies were carried out. Laparoscopic biopsy was taken, and histopathological correlation was made.

DISCUSSION

MR imaging is an excellent modality for providing details of structure within pelvis and for identifying various pathologies epicentered in ovary and uterus.

Ultrasound is considered the first-line imaging modality for the assessment of pelvic endometriosis because it is easily accessible, is non-invasive, and cost-effectiveness. But MRI is the modality of choice because of its greater field of view coverage, use of multiple sequences and excellent soft tissue contrast resolution that eventually aids in diagnosis.[12] Zuber et al did a study on magnetic resonance imaging of endometriosis: a common but often hidden, missed, and misdiagnosed entity mentioned that ultrasonography, including transvaginal sonography (TVS) and transrectal sonography (TRS), is the first-line imaging modality. On ultrasonography, endometrioma appears to be a well-defined thick-walled cystic lesion with uniform ground-glass internal echoes and no internal vascularity.[13]

Characterisation of endometriosis is done based on its appearance on T1 weighted images, T2 weighted images, DWI, hemo sequence and post contrast gadolinium T1 fs weighted subtraction images. T1 and T2 weighted images are basic sequences that play an important role in identification and characterisation. 18 out of 30 patients had T1 hyperintense signal intensity and 12 had iso to hypointense signal intensity. On T2 weighted imaging, 8 had low signal intensity or T2 shading, 9 had fluid-fluid levels, 2 had hyperintense signal intensity with suppression on TIRM and 7 with hyperintense signal intensity without suppression on TIRM.

Kido et al did a study on topic MRI in the diagnosis of endometriosis and related diseases mentioned that on MRI, the key imaging findings for diagnosing ovarian endometriotic cysts are T1-high signal multiplicity, T2-shading, and the T2 dark spot sign.[14]

Endometriosis have peculiar findings like high T1 weighted signal intensity with a lower T2 signal intensity (as compared with functional or simple ovarian cyst) known as T2 shading. It is more commonly bilateral and can be multifocal. It can show loss of signal intensity on STIR images and can show DWI restriction with corresponding low ADC values (T2 blackout effect).[4] In 1992, Togashi et al described a phenomenon called "T2 shading", referring to the focal or uniform loss of signal on the T2W sequence. They found sensitivity, specificity, and accuracy of T2 shading sign for the differentiation of endometrioma from other adnexal lesions to be 90%, 98%, and 96%, respectively.[15]

Lesion appearing hyperintense on T1/T2 WI with blooming on hemo sequence were diagnosed as haemorrhagic cyst and advised for 6 week follow up in which resolution of lesion was noted hence confirming the diagnosis.

Lesions appearing hyperechoic on ultrasound with posterior acoustic shadowing within and hyperintense on T1/T2 WI with suppression on T1fs images with multiple blooming foci on hemo sequence with enhancement of solid component was diagnosed as teratoma and confirmed surgically. Zuber M, Shoaib M, Kumari S. et al also said that mature cystic teratoma can be differentiated from endometrioma on T1W fat-suppressed images because teratoma shows signal suppression while endometrioma does not; instead, it becomes more conspicuous. However, loss of T1W hyperintensity on STIR is not specific to fat; endometrioma and haemorrhagic cyst may mimic mature cystic teratoma on STIR imaging because they have similar relaxation times as fat.[16]

Thick-walled hypoechoic lesions with internal debris having oblong shape when followed up on MRI showed variable appearance on T1/T2 WI depending on content within with no suppression on T1fs images and typical thick peripheral rim enhancement suggesting of tubo-ovarian abscess which was confirmed surgically.

Table 3: Imaging and differentiating features.

Entities	Characteristic imaging feature	Differentiating features
Haemorrhagic cyst	Hyperintense on T1/T2 with blooming on hemo sequence, usually unilateral	Can have septations and retracted clot. 6 weeks follow up advisable
Teratoma	Hyperintense on T1/T2 WI with suppression on T1 fs images with multiple blooming foci on hemo sequences, enhancement of solid component and peripheral cystic rim	Typical thick peripheral rim enhancement differentiates from endometriosis
Tubo-ovarian abscess	Iso/hypo/hyperintense on T1/T2 WI (depending on content within) with no suppression on T1Fs images and typical thick peripheral rim enhancement	Typical thick peripheral rim enhancement differentiates from endometriosis
Malignant ovarian mass	Variable appearance on T1/T2 WI with post contrast solid component enhancement with diffusion restriction and invasion with surrounding structures	Solid component enhancement, DWI restriction can be seen in benign endometriosis as well
Focal adenomyosis	An inside out process, appearing heterogenous on T1/T2 WI with cystic areas within with loss of Endo-myometrial junction	An outside in process, endo myometrial junction usually maintained

Lesions appearing as complex solid cystic (ORADS 3-5) on ultrasound were seen as complex mass lesions with their solid component showing enhancement on post gadolinium enhancement and were confirmed histopathologically. 1 out 30 cases was of malignant conversion of endometriosis in our study.

Based on their appearances on ultrasound and MRI, correlation with histopathological findings was made for all lesions and a significant Strength of association between ultrasound and histopathological findings was found (Cramer's V=0.49). For MRI the strength of association with histopathological findings was high (Cramer' V=0.71).

Main aim for diagnosing pathologies was to decide the mode of treatment to be followed as endometriosis requires surgical resection of endometriotic tissue with main aim of surgery being complete resection in one sitting.

The overall diagnostic accuracy for ultrasound in evaluation of endometriosis and differentiating it from its mimics was 76% and for MRI was 89%, making MRI the modality of choice for diagnosing, characterising endometriosis and differentiating it from its various mimics.

CONCLUSION

MRI is excellent in detecting endometriosis and differentiating it from its various mimics with an overall diagnostic accuracy of 89% and high strength of correlation with gold standard of diagnosis i.e., histopathology.

MRI being non-invasive can be easily done and therefore plays a crucial role in making correct diagnosis when combined with clinical history.

Thus, MRI plays a pivotal role in diagnosing endometriosis and differentiating various adnexal lesions which can mimic endometriosis.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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