

Original Research Article

EVALUATION OF ENDOMETRIOSIS AND OTHER PELVIC PATHOLOGIES: ROLE OF MAGNETIC RESONANCE IMAGING IN PREOPERATIVE DIAGNOSIS

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ABSTRACT

Background: Endometriosis is a common gynecological disorder that frequently presents with chronic pelvic pain, dysmenorrhea, infertility, and adnexal masses. Its clinical manifestations often overlap with other pelvic pathologies, making accurate preoperative diagnosis essential for appropriate management. **Objectives:** This study evaluated the role of magnetic resonance imaging (MRI) in the assessment of women with suspected endometriosis and other pelvic pathologies.

Materials and Methods: A hospital-based cross-sectional observational study was conducted at Surabhi Institute of Medical Sciences, Mittapally, Telangana, from January to December 2025. A total of 43 women with clinical suspicion of endometriosis underwent gynecological evaluation, ultrasonography, and pelvic MRI. MRI findings were correlated with operative findings, histopathology, and clinical follow-up where applicable. Data were analyzed using descriptive statistics.

Results: On ultrasonography, hypoechoic lesions with low-level ground glass echoes were the most common finding, observed in 13 (30.2%) patients, followed by hypoechoic lesions with internal reticular echoes in 10 (23.3%). On T2-weighted MRI, fluid-fluid level was the predominant feature, identified in 15 (34.9%) patients, while T2 shading was observed in 13 (30.2%). The most frequent final diagnosis was hemorrhagic cyst (13, 30.2%), followed by endometriosis (7, 16.3%) and teratoma (7, 16.3%). Tubo-ovarian abscess and focal adenomyosis accounted for 9.3% each, whereas hematosalpinx and endometrioid carcinoma were diagnosed in 7.0% each. Malignant transformation of endometriosis was identified in 4.7% of patients.

Conclusions: MRI is a valuable adjunct to ultrasonography in the evaluation of women with suspected endometriosis. Its superior soft tissue characterization facilitates differentiation of endometriosis from other pelvic pathologies, supports appropriate treatment planning, and contributes to improved gynecological management.

Keywords: Endometriosis; Magnetic resonance imaging; Pelvic pain; Adnexal masses; Differential diagnosis.

INTRODUCTION

Endometriosis is a chronic gynecological disorder characterized by the presence of functional endometrial glands and stroma outside the uterine cavity. It is one of the most common benign

diseases affecting women of reproductive age and is a major cause of chronic pelvic pain, dysmenorrhea, dyspareunia, infertility, and reduced quality of life.^[1] The exact cause remains unclear, with proposed mechanisms including retrograde menstruation, coelomic metaplasia, immune

dysfunction, and genetic predisposition. These mechanisms likely interact to produce the varied clinical manifestations seen in affected women.^[2,3]

The disease affects approximately 10% of women of reproductive age, with a prevalence of 20–50% among women presenting with infertility and up to 90% among those with chronic pelvic pain.^[4] Despite its high prevalence, diagnosis is often delayed because symptoms are nonspecific and overlap with those of several other gynecological disorders. Delayed diagnosis may result in progressive disease, worsening symptoms, impaired fertility, and a substantial impact on physical, emotional, and social well-being.^[5]

Endometriosis is classified into three main forms: superficial peritoneal endometriosis, ovarian endometrioma, and deep infiltrating endometriosis, the latter involving lesions that extend at least 5 mm beneath the peritoneal surface.^[6] Ovarian endometriomas are among the most common manifestations, while deep infiltrating endometriosis frequently affects the uterosacral ligaments, rectovaginal septum, bowel, urinary bladder, and pelvic sidewall, often requiring complex surgical management. Therefore, accurate identification of disease extent is important for treatment planning and fertility preservation.^[7]

Diagnosis relies on a combination of clinical history, physical examination, imaging findings, and histopathological confirmation when indicated.^[8] Although laparoscopy remains the gold standard for diagnosis, it is invasive and may not be suitable as the initial diagnostic approach.^[9] Consequently, imaging has become an essential part of the evaluation of suspected endometriosis. Ultrasonography is the first-line investigation because it is readily available and cost-effective; however, its findings are often nonspecific and may overlap with those of other pelvic pathologies.^[10]

MRI provides superior soft tissue contrast and a comprehensive evaluation of pelvic anatomy, making it particularly useful when ultrasound findings are inconclusive or deep infiltrating disease is suspected.^[11] Characteristic MRI features of endometriosis include T1-weighted hyperintensity with corresponding T2 signal loss (T2 shading), multifocal or bilateral lesions, signal loss on STIR sequences, and diffusion restriction with low ADC values.^[5] Deep infiltrating lesions typically appear as low-signal-intensity fibrotic nodules on T2-weighted images, most commonly involving the rectouterine pouch.^[12]

From a gynecological perspective, differentiating endometriosis from its mimics is essential because management strategies differ considerably. Conditions such as hemorrhagic cysts, mature cystic teratomas, tubo-ovarian abscesses or hydrosalpinx, malignant ovarian tumors, and focal adenomyosis often present with similar symptoms, including pelvic pain, dysmenorrhea, and adnexal masses.^[10,13] Accurate preoperative diagnosis helps guide appropriate medical or surgical treatment, improves

patient counseling, and minimizes unnecessary interventions. Therefore, the present study aimed to evaluate the role of MRI in characterizing endometriosis and differentiating it from common gynecological conditions that mimic its clinical and imaging presentation.

MATERIALS AND METHODS

Study design and participants: This hospital-based cross-sectional observational study was conducted in the Department of Obstetrics and Gynecology in collaboration with the Department of Radiodiagnosis at Surabhi Institute of Medical Sciences, Mittapally, Telangana, over a one-year period from January 2025 to December 2025. A total of 43 women of reproductive age presenting to the gynecology outpatient department or emergency department with symptoms suggestive of endometriosis, including chronic pelvic pain, dysmenorrhea, dyspareunia, infertility, abnormal uterine bleeding, or an adnexal mass, were enrolled in the study.

All patients underwent detailed history taking, clinical and pelvic examination, and routine gynecological evaluation by consultant gynecologists. Women with clinical or ultrasonographic suspicion of endometriosis or other pelvic masses requiring further evaluation were included. Patients with contraindications to MRI, pregnancy, previous definitive surgery for endometriosis, or refusal to participate were excluded. Written informed consent was obtained from all participants before enrollment, and the study was approved by the Institutional Ethics Committee.

Imaging evaluation: Pelvic ultrasonography was performed as the initial imaging modality for all patients. Those requiring further characterization of pelvic lesions subsequently underwent contrast-enhanced magnetic resonance imaging (MRI) using a 1.5-Tesla Philips MRI scanner. The MRI protocol included axial and sagittal T1-weighted and T2-weighted sequences, coronal T2-weighted images, T1 fat-saturated (T1 FAT SAT) sequences, turbo inversion recovery magnitude (TIRM) sequences, hemo sequences, diffusion-weighted imaging (DWI), apparent diffusion coefficient (ADC) mapping, and post-contrast T1-weighted GAD VIBE sequences. MRI findings were reviewed for lesion location, morphology, signal characteristics, and associated pelvic involvement to aid in differentiating endometriosis from other gynecological conditions such as hemorrhagic cysts, tubo-ovarian abscesses, teratomas, adenomyosis, and ovarian malignancies.

Final Diagnosis: The final diagnosis was established using operative findings and histopathological examination wherever surgery was performed. In patients managed conservatively, the diagnosis was based on a combination of clinical

findings, imaging features, and follow-up evaluation. Clinical, ultrasonographic, MRI, operative, and histopathological data were recorded using a structured case record form.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 27.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were summarized as frequencies and percentages. The distribution of ultrasonographic findings, MRI characteristics, and final diagnoses was analyzed using descriptive statistics and presented in tabular form.

RESULTS

Among the 43 patients, the most common ultrasonographic appearance was hypoechoic lesions with low-level ground glass echoes, observed in 13 (30.2%) patients. This was followed by hypoechoic lesions with internal reticular echoes in 10 (23.3%) patients and solid cystic lesions with heterogeneity in 9 (20.9%) patients. Hyperechoic lesions were identified in 7 (16.3%) patients, while thick-walled hypoechoic lesions with internal debris were the least common finding, seen in 4 (9.3%) patients. These findings indicate that hypoechoic lesions with characteristic ground glass echoes were the predominant ultrasonographic pattern in the study population.

Table 1: Distribution of study participants according to the appearance of lesions on ultrasonography (N = 43)

Lesions	Number (n)	Percentage (%)
Hypoechoic with internal reticular echoes	10	23.3
Hypoechoic with low-level ground glass echoes	13	30.2
Thick-walled hypoechoic lesion with internal debris	4	9.3
Hyperechoic	7	16.3
Solid cystic lesion with heterogeneity	9	20.9
Total	43	100.0

Among the 43 patients, the most common T2-weighted MRI finding was fluid–fluid level, observed in 15 (34.9%) patients. Low signal intensity or T2 shading was seen in 13 (30.2%) patients, while hyperintense signal intensity without suppression on TIRM was present in 12 (27.9%)

patients. Hyperintense signal intensity with suppression on TIRM was the least common finding, identified in 3 (7.0%) patients. Overall, fluid–fluid levels and T2 shading were the predominant MRI features observed in the study population.

Table 2: Distribution of study participants according to T2-weighted MRI findings (N = 43)

Appearance on T2-weighted image	Number of patients (n)	Percentage (%)
Low signal intensity or shading	13	30.2
Fluid–fluid level	15	34.9
Hyperintense signal intensity with suppression on TIRM	3	7.0
Hyperintense signal intensity without suppression on TIRM	12	27.9
Total	43	100.0

Among the 43 patients, haemorrhagic cyst was the most common diagnosis, accounting for 13 (30.2%) cases. Teratoma and endometriosis were the next most frequent diagnoses; each identified in 7 (16.3%) patients. Tubo-ovarian abscess and focal adenomyosis were observed in 4 (9.3%) patients each. Hematosalpinx and endometrioid cancer were

diagnosed in 3 (7.0%) patients each, while malignant transformation of endometriosis was the least common diagnosis, seen in 2 (4.7%) patients. These findings demonstrate a broad spectrum of pelvic pathologies, with haemorrhagic cysts being the predominant diagnosis in the study population.

Table 3: Distribution of final diagnoses among the study participants (N = 43)

Diagnosis	Number of patients (n)	Percentage (%)
Haemorrhagic cyst	13	30.2
Teratoma	7	16.3
Tubo-ovarian abscess	4	9.3
Hematosalpinx	3	7.0
Endometrioid cancer	3	7.0
Focal adenomyosis	4	9.3
Malignant transformation of endometriosis	2	4.7
Endometriosis	7	16.3
Total	43	100.0

DISCUSSION

Endometriosis remains one of the most challenging gynecological disorders to diagnose because its symptoms often overlap with those of several benign and malignant pelvic conditions. Women commonly present with dysmenorrhea, chronic pelvic pain, dyspareunia, infertility, or adnexal masses, making accurate preoperative diagnosis essential for appropriate treatment planning. Although ultrasonography is the first-line imaging modality because of its accessibility, low cost, and ease of use, MRI provides additional information when the diagnosis is uncertain or when deep pelvic disease and complex adnexal lesions are suspected.^[10]

In the present study, the most common ultrasonographic appearance was hypoechoic lesions with low-level ground glass echoes (30.2%), followed by hypoechoic lesions with internal reticular echoes (23.3%) and solid cystic lesions with heterogeneity (20.9%). These findings are consistent with the characteristic sonographic appearance of ovarian endometriomas described by Zuber et al., who reported that endometriomas typically appear as thick-walled cystic lesions with homogeneous low-level ground glass echoes and minimal internal vascularity.^[14] However, similar sonographic appearances may also be encountered in hemorrhagic cysts and other adnexal masses, highlighting the limitations of ultrasonography in differentiating these conditions.

MRI complements ultrasonography by providing superior soft tissue contrast and better delineation of lesion characteristics. In our study, the most frequent T2-weighted MRI finding was fluid–fluid level, observed in 34.9% of patients, followed by low signal intensity (T2 shading) in 30.2% and hyperintense signal intensity without suppression on TIRM in 27.9%. Only 7.0% of patients demonstrated hyperintense signal intensity with suppression on TIRM. These findings support the established role of MRI in characterizing hemorrhagic and endometriotic lesions. Kido et al. reported that T1 hyperintensity, T2 shading, and the T2 dark spot sign are among the most characteristic MRI features of ovarian endometriomas.^[15] Similarly, Togashi et al. demonstrated that the T2 shading sign is highly valuable in differentiating endometriomas from other adnexal cystic lesions.^[16] Recognition of these imaging patterns helps improve diagnostic confidence, particularly in women with equivocal ultrasonographic findings. The spectrum of final diagnoses in our study highlights the importance of considering alternative gynecological pathologies in women presenting with pelvic pain. Hemorrhagic cysts were the most common diagnosis, accounting for 30.2% of cases, followed by endometriosis and teratoma, each constituting 16.3% of the study population. Tubo-ovarian abscess and focal adenomyosis each

accounted for 9.3%, while hematosalpinx and endometrioid cancer were identified in 7.0% of patients each. Malignant transformation of endometriosis was uncommon, occurring in 4.7% of cases. These findings demonstrate that several gynecological conditions can mimic endometriosis clinically and on initial imaging, emphasizing the need for careful evaluation before treatment decisions are made.^[17]

Differentiating these conditions has important therapeutic implications. Hemorrhagic cysts are often managed conservatively with interval follow-up, whereas tubo-ovarian abscesses require prompt antibiotic therapy with or without surgical drainage. Mature cystic teratomas generally require surgical excision because of the risk of torsion and other complications, while endometriosis requires individualized management depending on symptom severity, disease extent, fertility desires, and patient preference. Suspicion of malignancy warrants timely referral to gynecologic oncology for definitive management. Therefore, accurate preoperative characterization of adnexal lesions is essential to avoid unnecessary procedures and to facilitate appropriate counseling and treatment.^[18]

Overall, our findings reinforce the complementary roles of ultrasonography and MRI in the evaluation of women with suspected endometriosis. Ultrasonography remains the preferred initial investigation, while MRI serves as a valuable problem-solving tool when lesions are indeterminate or when detailed assessment of disease extent is required. From a gynecological perspective, accurate differentiation between endometriosis and its mimics supports appropriate clinical decision-making, improves surgical planning, and contributes to better patient outcomes.

CONCLUSION

Endometriosis continues to be an important diagnostic challenge because its clinical presentation frequently overlaps with that of several benign and malignant gynecological conditions. In the present study, hemorrhagic cysts, endometriosis, teratomas, tubo-ovarian abscesses, adenomyosis, hematosalpinx, and endometrioid carcinoma demonstrated considerable overlap in their presenting symptoms, emphasizing the need for accurate preoperative evaluation. While ultrasonography remains the preferred initial imaging modality, MRI provides valuable additional information for characterizing indeterminate adnexal lesions and assessing the extent of pelvic disease. The complementary use of ultrasonography and MRI facilitates more accurate differentiation of endometriosis from its mimics, enabling appropriate treatment planning, improved surgical decision-making, and better patient counseling. Early and accurate diagnosis is essential to optimize clinical outcomes, preserve fertility whenever possible, and

avoid unnecessary interventions in women presenting with suspected endometriosis.

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