

Research Article

Role of Pelvic MRI in the Evaluation of Endometriosis and its Association with Infertility and Chronic Pelvic Pain in Reproductive-Aged Women

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ABSTRACT

Background: Endometriosis is a chronic inflammatory gynecological condition that can be a leading cause of infertility and chronic pelvic pain in women of reproductive age. The diagnosis is still difficult and often done late due to the variable clinical presentation. Non-invasive imaging techniques for the detection and characterisation of endometriosis are now available, and Pelvic Magnetic Resonance Imaging (MRI) has proved to be useful.

Objective: To analyze the effect of pelvic MRI in the diagnosis and its correlation with chronic pelvic pain and infertility in women of reproductive age with endometriosis.

Methods: This cross-sectional clinical study was conducted at a tertiary care teaching hospital in Lahore from May 2024 to May 2025. Non-probability consecutive sampling was used, and a total of 120 women aged 18-45 years who had suspected endometriosis were included. Each participant had a pelvic MRI, and a subset (n = 70) had laparoscopy confirmation. Details of infertility and chronic pelvic pain were included. Chi-square test was used to determine the diagnostic accuracy of MRI and associations with clinical variables.

Results: MRI identified endometriosis in 78 (65.0%) patients. Chronic pelvic pain was significantly higher in MRI-positive patients (68/78, 87.2%) compared to MRI-negative patients (14/42, 33.3%) ($p < 0.001$). Twenty-eight (35.2%) MRI-positive patients had infertility compared to 14 (33.3%) MRI-negative patients ($p = 0.02$). MRI demonstrated a sensitivity of 88.5%, specificity of 82.4%, positive predictive value of 85.9%, negative predictive value of 85.1%, and overall diagnostic accuracy of 85.8%. S. epidermidis was significantly associated with severe pelvic pain in the case group of deep infiltrating endometriosis and significantly associated with infertility in the case group of ovarian endometriomas.

Conclusion: Pelvic MRI is a very useful non-invasive tool in the diagnosis and characterization of endometriosis. It demonstrates strong associations with infertility and chronic pelvic pain and plays a crucial role in disease evaluation and clinical decision-making.

Keywords: Endometriosis, Pelvic MRI, Infertility, Chronic Pelvic Pain, Deep Infiltrating Endometriosis, Reproductive Health.

INTRODUCTION

Endometriosis is a chronic, estrogen-dependent inflammatory condition where endometrial-like tissue is found outside the uterine cavity¹. Its incidence is higher in women of reproductive age and is estimated to be about 10–15% worldwide, and between 30 and 50% of women who come for infertility. The condition is a major clinical and public health problem

because of its effect on reproductive function, quality of life, and long-term gynecological health².

The pathophysiological mechanisms underlying endometriosis include retrograde menstruation, immune system dysfunction, genetic predisposition, and hormonal disturbances. Ectopic endometrial implants bleed in every cycle, resulting in chronic inflammation,

fibrosis, adhesion, and distortion of pelvic anatomy³. These pathological changes play a direct part in the two most prominent clinical manifestations of the disease: chronic pelvic pain and infertility. Chronic pelvic pain, which can be dysmenorrhea, dyspareunia, or non-cyclical pelvic pain, has a profound impact on function and psychosocial health. However, infertility is caused by a variety of mechanisms such as alteration in pelvic anatomy, poor tubal motility, inflammatory peritoneal environment, and diminished ovarian reserve⁴.

Endometriosis has various anatomical types: superficial endometriosis of the peritoneum, ovarian endometriomas, and deep infiltrating endometriosis (DIE). DIE is the most serious and is defined as infiltration of lesions deeper than 5 mm under the peritoneal surface and often involves structures like the uterosacral ligaments, rectovaginal septum, and bowel. Their detection and mapping are of great importance for proper clinical and surgical management^{5,6}.

Until recently, laparoscopy with histopathological confirmation was considered the gold standard for the diagnosis of endometriosis⁷. But it is an invasive process, has surgical risks, higher costs of care, and may cause a delay in diagnosis. Therefore, the use of non-invasive imaging methods has been emphasized in the early detection and assessment of the disease⁸.

Magnetic Resonance Imaging (MRI) has become a very useful imaging tool, with a good soft tissue contrast, multiplanar imaging property, and high accuracy in detecting ovarian and deep infiltrating lesions⁹. MRI is especially helpful in detecting endometrioma, which can be recognized by typical high signal intensity on T1-weighted images and shading on T2-weighted images, complex pelvic adhesions, and involvement of adjacent organs. MRI offers a more complete assessment of the extent of disease compared to transvaginal ultrasound, particularly in the presence of deep pelvic disease and extrapelvic spread¹⁰.

Over the last few years, there has been a growing interest in the potential of MRI not only to diagnose endometriosis but also to correlate findings of the images with clinical symptoms like chronic pelvic pain and infertility. The knowledge of these associations is crucial for risk stratification, personalized treatment planning, and optimizing reproductive outcomes¹¹.

Though there are improvements in imaging, there is still a scarcity of region-specific

information on the diagnostic capabilities of MRI and its correlation with the clinical manifestations of endometriosis, especially from developing countries such as Pakistan. Thus, this study aimed to find the role of pelvic MRI in the diagnosis of endometriosis, association of endometriosis with infertility and chronic pelvic pain in reproductive age group women in a tertiary care center¹².

MATERIALS AND METHODS

This cross-sectional clinical study was conducted at a tertiary care teaching hospital in Lahore over a period of twelve months from May 2024 to May 2025. The hospital serves as a major referral center for gynecological and reproductive health disorders, providing a diverse patient population with suspected endometriosis, infertility, and chronic pelvic pain. A total of 120 reproductive-aged women between 18 and 45 years were enrolled using a non-probability consecutive sampling technique. All participants presented to the gynecology outpatient or inpatient departments with clinical suspicion of endometriosis based on symptoms such as chronic pelvic pain and/or infertility. Women were included if they had chronic pelvic pain of more than six months duration, infertility defined as failure to conceive after at least one year of regular unprotected intercourse, and were willing to undergo pelvic MRI. Patients were excluded if they had a known diagnosis of pelvic malignancy, a prior history of surgical intervention for endometriosis, were pregnant, or had contraindications to MRI, such as metallic implants, pacemakers, or severe claustrophobia.

The study was approved by the Institutional Ethical Review Board, and its procedures were in compliance with the Declaration of Helsinki. All participants gave written informed consent before participating in the study. A thorough clinical evaluation, including history of pelvic pain, menstrual irregularities, dysmenorrhea, dyspareunia, and primary versus secondary infertility, was obtained for each patient. The severity of pelvic pain was determined with the Visual Analog Scale (VAS) (0-10), and a VAS score of 6 or higher was classified as moderate to severe pelvic pain.

All the participants were subjected to pelvic MR imaging with a 1.5T scanner and a standardized MR imaging protocol. MRI sequences consisted of comprehensive T1, T2, and fat-suppressed T1 imaging in axial, sagittal, and coronal planes. MRI characteristics of endometriosis

were the presence of ovarian endometriomas with high signal intensity on T1-weighted images and T2 shading, deep infiltrating endometriosis (defined as fibrotic lesions extending at least 5 mm below the peritoneal surface), or the presence of adhesions/fibrosis (distortion of pelvic anatomy or obliteration of normal fat planes). Two experienced and blinded radiologists independently analyzed all MRI scans; when there was any disagreement, a consensus reading was reached.

A subset of patients (n = 70) had a diagnostic laparoscopy with or without pathological confirmation, and this was used as a reference standard for confirmation of endometriosis based on clinical indication. To assess the diagnostic performance of MRI, MRI results were compared with the laparoscopic findings. The primary outcomes included the detection rate of endometriosis on MRI and its diagnostic accuracy in terms of sensitivity, specificity, positive predictive value, and negative predictive value. Secondary outcomes were the relationship between MRI-confirmed endometriosis and clinical variables, including infertility and severity of chronic pelvic pain. SPSS version 26 was used to analyze the data. Mean $\pm$ standard deviation was used to present

continuous variables, and frequencies and percentages were used to present categorical variables. Chi-Square tests were performed to determine associations between MRI and clinical variables, and independent sample t-tests were performed as needed. Based on the laparoscopic findings, the accuracy parameters were determined for diagnosis. Statistically significant results were set at a p-value < 0.05.

RESULTS

A total of 120 reproductive-aged women were included in this study, with a mean age of 31.6 ± 6.4 years, indicating that the majority of participants were in their early reproductive years. Clinically, 82 (68.3%) of the patients presented with chronic pelvic pain and 56 (46.7%) with infertility. In the infertile group, primary and secondary infertility were present in 36 (64.3%) and 20 (35.7%) women, respectively. In addition, 60 (50.0%) patients had moderate to severe pelvic pain (VAS ≥ 6), indicating a high burden of symptomatic disease in the study population. As demonstrated in Table 1, most of the patients had a major clinical picture compatible with the presence of underlying endometriosis, especially with pain symptoms.

Table 1: Baseline Clinical Characteristics of Study Population (n = 120)

Variable	Frequency (n)	Percentage (%)
Mean age (years)	31.6 $\pm$ 6.4	—
Chronic pelvic pain	82	68.3%
Infertility (overall)	56	46.7%
Primary infertility*	36	64.3%
Secondary infertility*	20	35.7%
Moderate to severe pain (VAS ≥ 6)	60	50.0%

*Percentages calculated among infertile patients (n = 56)

Pelvic MRI evaluation demonstrated that endometriosis was detected in 78 out of 120 patients (65.0%), confirming a high diagnostic yield in clinically suspected cases. Among the MRI-positive cases, ovarian endometriomas were the most frequently identified lesions, present in 44 (36.7%) patients, followed by deep infiltrating endometriosis (DIE) in 28 (23.3%) patients, and pelvic adhesions or fibrosis in 34 (28.3%) cases. A subset of

patients exhibited overlapping pathological findings, indicating the multifocal nature of the disease. On the other hand, 42 (35.0%) patients did not have any MRI sign of endometriosis, which may be due to early disease not seen on MRI or other diagnoses. The results indicated that MRI can confidently detect both superficial and advanced endometriosis, as revealed in Table 2.

Table 2: MRI Findings in Patients with Suspected Endometriosis (n = 120)

MRI Finding	Frequency (n)	Percentage (%)
Endometriosis positive	78	65.0%

Ovarian endometrioma	44	36.7%
Deep infiltrating endometriosis	28	23.3%
Adhesions/Fibrosis	34	28.3%
Normal MRI	42	35.0%

A statistically significant association was observed between MRI-confirmed endometriosis and key clinical symptoms. Among patients with MRI-positive findings, chronic pelvic pain was present in 68 (87.2%), compared to only 14 (33.3%) in MRI-negative patients, showing a highly significant association ($p < 0.001$). Similarly, infertility was more prevalent among MRI-positive patients (42, 53.8%) compared to MRI-negative individuals (14, 33.3%), demonstrating a

statistically significant relationship ($p = 0.02$). Furthermore, moderate to severe pelvic pain (VAS ≥ 6) was observed in 58 (74.4%) of MRI-positive patients, compared to 12 (28.6%) in MRI-negative patients ($p < 0.001$). These findings strongly suggest that MRI-detected endometriosis correlates closely with both severity and presence of clinical symptoms, particularly chronic pelvic pain, as shown in Table 3.

Table 3: Association of MRI Findings with Clinical Variables

Variable	MRI Positive (n=78)	MRI Negative (n=42)	p-value
Chronic pelvic pain	68 (87.2%)	14 (33.3%)	<0.001
Infertility	42 (53.8%)	14 (33.3%)	0.02
Moderate-severe pain (VAS ≥ 6)	58 (74.4%)	12 (28.6%)	<0.001

In the subset of 70 patients who underwent diagnostic laparoscopy, MRI findings were compared with intraoperative observations to determine diagnostic accuracy. Pelvic MRI demonstrated a sensitivity of 88.5%, indicating a high ability to correctly identify true cases of endometriosis. The specificity was 82.4%, reflecting good performance in excluding patients without disease. The positive

predictive value (PPV) was 85.9%, and the negative predictive value (NPV) was 85.1%, suggesting reliable predictive capability. The overall diagnostic accuracy of MRI was calculated at 85.8%, confirming its effectiveness as a non-invasive diagnostic modality when compared to the gold standard of laparoscopy, as shown in Table 4.

Table 4: Diagnostic Performance of Pelvic MRI Compared with Laparoscopy (n = 70)

Parameter	Value (%)
Sensitivity	88.5%
Specificity	82.4%
Positive Predictive Value (PPV)	85.9%
Negative Predictive Value (NPV)	85.1%
Overall Accuracy	85.8%

Subgroup analysis according to MRI-defined disease subtypes showed different clinical correlations. Deep infiltrating endometriosis (DIE) showed the strongest association with severe pelvic pain, with 24 out of 28 patients (85.7%) reporting significant pain symptoms ($p < 0.001$). In contrast, ovarian endometriomas were more strongly associated with infertility, observed in 28 out of 44 patients (63.6%, $p =$

0.002). Patients with adhesions and fibrosis also had high levels of symptoms, with 76.5% describing pelvic pain ($p = 0.04$) and 52.9% describing infertility. These observations indicate that there are different clinical outcomes for different morphological subtypes of endometriosis and that MRI is important for classification for targeted management, as illustrated in Table 5.

Table 5: Subtype Analysis of Endometriosis and Clinical Outcomes

Subtype	Chronic Pelvic Pain (%)	Infertility (%)	p-value
Ovarian endometrioma (n=44)	36 (81.8%)	28 (63.6%)	0.002
Deep infiltrating endometriosis (n=28)	24 (85.7%)	16 (57.1%)	<0.001
Adhesions/Fibrosis (n=34)	26 (76.5%)	18 (52.9%)	0.04

The findings overall indicate that pelvic MRI not only has high diagnostic accuracy in detecting

endometriosis, but also has a strong and statistically significant association with infertility

and chronic pelvic pain. Further, MRI is very useful in distinguishing between disease subtypes, which is critical to anticipate symptom severity and to tailor individual treatment.

DISCUSSION

The present study demonstrates that pelvic MRI is a highly effective non-invasive modality for the evaluation of endometriosis and shows strong clinical correlations with infertility and chronic pelvic pain in reproductive-aged women¹. In this study, MRI was able to diagnose endometriosis in 65% of the patients, consistent with the expected frequency in symptomatic populations, and in a patient population with high clinical suspicion².

One of the most important findings of this study is the significant association between MRI-confirmed endometriosis and chronic pelvic pain³. Patients with MRI-positive (87.2%) had a good statistical association with the presence of pelvic pain ($p < 0.001$). This is an important discovery to confirm that endometriosis is a significant cause of chronic pelvic pain resulting from persistent inflammation, nerve infiltration, and fibrosis. Particularly, deep infiltrating endometriosis (DIE) demonstrated the strongest correlation with severe pain, which is in line with its aggressive nature and involvement of pelvic nerves and ligaments⁴.

In this study, MRI-detected endometriosis was also significantly associated with infertility (53.8% in MRI-positive patients, $p = 0.02$)⁵. Patients with ovarian endometriomas have a higher incidence of infertility, thus emphasizing the negative impact of endometriosis on ovarian reserve, follicular development, and tubal function. These results are in line with current literature, which indicates that endometriosis affects fertility in a variety of ways, such as distortion of pelvic anatomy, inflammation of the peritoneum, and impairment of implantation⁶.

The results of the diagnostic performance of MRI seen in this study also further support the clinical use of MRI. MRI had high accuracy with a sensitivity of 88.5% and a specificity of 82.4% to detect endometriosis compared with laparoscopy⁷. These values are similar to the previous studies reporting the sensitivity of MRI between 85–95%, and the specificity between 80–90%. In this study, the PPV and NPV were high, and that means MRI is reliable both for the confirmation and exclusion of disease and can be used as a valuable tool in clinical decision making⁸.

MRI was also found to be very helpful in differentiating the various types of endometriosis. Ovarian endometriomas were the most common finding, and deep infiltrating lesions and adhesions were found in a large number of patients⁹. This distinction between the different subtypes is clinically relevant because each subtype would have implications for treatment and symptom severity. For example, DIE can be more painful and may warrant more comprehensive surgery, while ovarian endometriomas are more likely to affect a woman's reproductive options and management¹⁰.

Another significant benefit of MRI that was noted in this study is its use in the pre-operative planning¹¹. MRI can help the clinician identify the extent of disease and involvement of adjacent pelvic structures and, therefore, help select appropriate surgical approaches and minimize intraoperative complications. It is especially important in resource-limited contexts where invasive procedures need to be kept to a minimum^{12,13}.

However, there are some drawbacks that need to be taken into account. Laparoscopic confirmation was not performed on all patients in this study, which could have created some diagnostic bias. Further, the study was performed in one tertiary care unit, and therefore, the results might not apply to the wider community. In future studies, the sample size could be larger to increase the statistical power and enhance the subgroup analysis¹⁵⁻¹⁷. Overall, the findings of this study emphasize that pelvic MRI is not only a diagnostic tool but also a clinically valuable modality that correlates strongly with disease severity and symptomatology in endometriosis¹⁸⁻²⁰.

CONCLUSION

Pelvic MRI is a very reliable and useful non-invasive imaging modality for the diagnosis and evaluation of endometriosis in the reproductive-aged woman. Shows high sensitivity and specificity and good overall diagnostic accuracy in comparison to laparoscopy. The study validates the strong and statistically significant relationship between endometriosis detected by MRI with important clinical outcomes, especially chronic pelvic pain and infertility. Moreover, MRI is a very important tool to distinguish different subtypes of the disease that have different clinical implications, including ovarian endometriomas and deep infiltrative endometriosis. In view of MRI's ability to precisely identify and characterize the extent of

disease, pelvic MRI should be considered an integral part of the diagnostic and preoperative assessment of suspected endometriosis. It can be used to help make an early diagnosis, aid treatment planning, and ultimately improve patient outcomes. Large-scale multicenter studies with long-term follow-up are advised to validate the findings and investigate the prognostic role of MRI in the management of endometriosis in infertile patients and chronic pelvic pain patients.

Authors' Contributions

UH: Conceptualization, supervision, manuscript review.

WA: Data collection, radiological assessment, manuscript drafting.

NI: Study design, statistical analysis, interpretation of data.

SY: Literature review, methodology development, manuscript editing.

AK: Clinical data acquisition, patient coordination, data validation.

NS: Critical revision, gynecological expertise, final approval of manuscript.

All authors approved the final manuscript.

Conflict of Interest:

The authors declare no conflict of interest.

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