

DIAGNOSTIC ACCURACY OF NON-CONTRAST MRI FOR DETECTING ENDOMETRIAL CARCINOMA: A CROSS-SECTIONAL STUDY AGAINST HISTOPATHOLOGY IN A PAKISTANI TERTIARY-CARE CENTER

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ABSTRACT

Background: Endometrial carcinoma is the most common gynecologic malignancy, and timely, accurate diagnosis guides definitive management. In resource-variable settings such as Pakistan, a robust, non-contrast MRI protocol could offer practical diagnostic value alongside histopathology.

Objective: To determine the diagnostic accuracy of magnetic resonance imaging (MRI) in detecting endometrial carcinoma, using histopathology as the gold standard.

Methods: We conducted a cross-sectional descriptive study at the Department of Radiology, Liaquat University Hospital, Hyderabad, over six months (ethical approval: CPSP/REU/RAD-2018-164-2697). Consecutive women aged 18–65 years with clinical suspicion of endometrial carcinoma underwent pelvic MRI using non-contrast T1-weighted, T2-weighted, and diffusion-weighted (DWI) sequences. Images were reported by a senior radiologist (≥ 3 years post-training). Histopathology from endometrial biopsy served as the reference standard. Diagnostic indices—sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), overall accuracy—and receiver operating characteristic (ROC) area under the curve (AUC) were calculated.

Results: A total of 227 women were included (mean age 49.6 ± 8.7 years); 62.6% were postmenopausal. Histopathology confirmed carcinoma in 102 (44.9%). MRI identified 110 positives, yielding 94 true positives, 16 false positives, 8 false negatives, and 109 true negatives. MRI performance was: sensitivity 92.1% (95% CI ~ 85.3 –96.0), specificity 87.2% (95% CI ~ 80.2 –92.0), PPV 85.5% (95% CI ~ 77.7 –90.8), NPV 93.2% (95% CI ~ 87.1 –96.5), and overall accuracy 89.9%. The ROC AUC was 0.90, indicating excellent discrimination. Subgroup analysis showed slightly higher accuracy in postmenopausal vs premenopausal women (91.5% vs 87.1%).

Conclusion: Non-contrast multiparametric MRI (T1/T2/DWI) demonstrated high accuracy for detecting endometrial carcinoma against histopathology, with a strong NPV that can confidently exclude disease in many clinically suspected cases. These findings support MRI as a practical, reliable adjunct to guide diagnostic and preoperative pathways in our tertiary-care setting.

Keywords: Endometrial Neoplasms; Magnetic Resonance Imaging; Diffusion Magnetic Resonance Imaging; Sensitivity and Specificity; Pakistan

INTRODUCTION

Endometrial carcinoma (EC) is the most common gynecological malignancy worldwide and its incidence continues to rise. In 2020,

approximately 417,000 new cases and 97,000 deaths were attributed to EC globally.^[1] The disease is most frequent in postmenopausal women and is strongly linked to risk factors such

as obesity, unopposed estrogen exposure, nulliparity, and hereditary syndromes like Lynch syndrome.^[2]

In Pakistan, corpus uteri cancers represent a significant fraction of gynecological malignancies. Data from a tertiary centre in Karachi indicated that uterine cancers comprised 33.8% of all gynecological malignancies, second only to ovarian cancer (49.3%).^[3] This highlights the importance of strengthening diagnostic strategies in our local context. Early and accurate detection remains crucial since prognosis depends heavily on tumour grade, depth of myometrial invasion, cervical involvement, and lymphovascular invasion.^[4]

Transvaginal ultrasound (TVUS) and endometrial sampling (e.g., Pipelle biopsy or dilatation and curettage) are frequently employed as first-line diagnostic tools. However, both have limitations: TVUS may lack specificity in differentiating malignant from benign lesions, while endometrial sampling can miss focal or heterogeneous disease. A meta-analysis of 18 studies involving 1,548 patients showed that TVUS had pooled sensitivity and specificity of 76.6% and 87.4% respectively for detecting deep myometrial invasion, whereas MRI demonstrated pooled sensitivity of 81.1% and specificity of 83.8%.^[5]

MRI offers superior soft tissue resolution and multiplanar capability, making it invaluable for evaluating tumour detection, depth of myometrial invasion, and cervical involvement. Meta-analyses have reported pooled sensitivity between 74–79% and specificity of 81–82% for MRI in predicting deep myometrial invasion and high-grade disease.^[6] A study from Liaquat University of Medical & Health Sciences (LUMHS), Jamshoro, reported that MRI achieved sensitivity of 90% and specificity of 82% for detecting cervical stromal invasion, with positive predictive value (PPV) 86% and negative predictive value (NPV) 97%.^[7]

Nevertheless, diagnostic accuracy of MRI shows variability across studies due to differences in imaging protocols, radiologist expertise, and patient characteristics. More locally generated evidence is needed to confirm MRI's role in detecting EC when compared to histopathology, which remains the gold standard.

The present study was therefore undertaken to determine the diagnostic accuracy of MRI in detecting endometrial carcinoma among women presenting with clinical suspicion in a Pakistani tertiary care setting, using histopathology as the reference standard.

OBJECTIVE

To determine the diagnostic accuracy of magnetic resonance imaging (MRI) in detecting endometrial carcinoma, using histopathology as the gold standard, among women presenting with clinical suspicion of the disease in a tertiary care setting in Pakistan.

METHODOLOGY

This was a cross-sectional descriptive study conducted at the Department of Radiology, Liaquat University Hospital, Hyderabad, over six months. Ethical approval was obtained from the College of Physicians and Surgeons of Pakistan (Approval Ref. CPSP/REU/RAD-2018-164-2697).

Written informed consent was taken from all participants. A total of 227 female patients were recruited using non-probability consecutive sampling. Sample size was calculated based on expected sensitivity (90.4%), specificity (66.1%), 95% confidence level, and 10% precision.

Eligibility Criteria

Women between 18 and 65 years of age presenting with suspected endometrial carcinoma were included if they had symptoms such as abnormal uterine bleeding, heavy menstrual bleeding, or postmenopausal bleeding. Patients were excluded if they were in the active phase of menstruation, were currently receiving hormonal therapy, or were pregnant.

Procedure

Eligible patients underwent clinical evaluation followed by MRI pelvis using standard sequences (T1-weighted, T2-weighted, diffusion-weighted imaging). A senior radiologist with at least three years' post-training experience interpreted the scans. Findings were recorded as positive or negative for endometrial carcinoma. For confirmation, endometrial biopsy samples were obtained and examined by a consultant histopathologist, who provided the final diagnosis (gold standard).

Data Analysis

Data were analyzed using SPSS v21.0. Qualitative variables such as marital status, menopausal status, and MRI and histopathology results were summarized as frequencies and percentages. Quantitative variables, including age and duration of symptoms, were expressed as mean $\pm$ standard deviation. The diagnostic performance of MRI was assessed against histopathology (gold standard) by calculating sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy. Potential effect modifiers, including age, parity, and menopausal status,

were controlled through stratification, and diagnostic accuracy was recalculated post-stratification.

RESULTS

A total of 227 women meeting the inclusion criteria were enrolled in the study. The mean age of participants was 49.6 ± 8.7 years (range 28–65 years). Of these, 142 (62.6%) were postmenopausal and 85 (37.4%) were premenopausal. The most common presenting complaint was abnormal uterine bleeding (158 patients, 69.6%), followed by postmenopausal bleeding (51 patients, 22.5%) and heavy menstrual bleeding (18 patients, 7.9%).

Table 01: Basic Demographics

Variable	Value
Mean Age (years)	49.6 ± 8.7
Premenopausal	85 (37.4%)
Postmenopausal	142 (62.6%)
Abnormal uterine bleeding	158 (69.6%)
Postmenopausal bleeding	51 (22.5%)
Heavy menstrual bleeding	18 (7.9%)

MRI vs. Histopathology Findings

Histopathology confirmed endometrial carcinoma in 102 patients (44.9%), while 125 patients (55.1%) had benign findings (including hyperplasia without atypia, polyps, or normal

endometrium). MRI identified endometrial carcinoma in 110 patients. Compared with histopathology, MRI correctly diagnosed 94 true positives and 109 true negatives. There were 16 false positives and 8 false negatives.

Table 02: 2 x 2 Contingency Table

	Histopathology Positive	Histopathology Negative
MRI Positive	94	16
MRI Negative	8	109

Table 03: Diagnostic Performance of MRI vs Histopathology

Measure	Value
Sensitivity	92.10%
Specificity	87.20%
Positive Predictive Value (PPV)	85.50%
Negative Predictive Value (NPV)	93.20%
Overall Accuracy	89.90%

Effect Modifiers

Subgroup analysis demonstrated that diagnostic accuracy was slightly higher in postmenopausal women (91.5%) compared to premenopausal

women (87.1%). No significant difference was observed with respect to parity or age stratification.

Figure 01: ROC Curve

ROC Curve for MRI in Detecting Endometrial Carcinoma

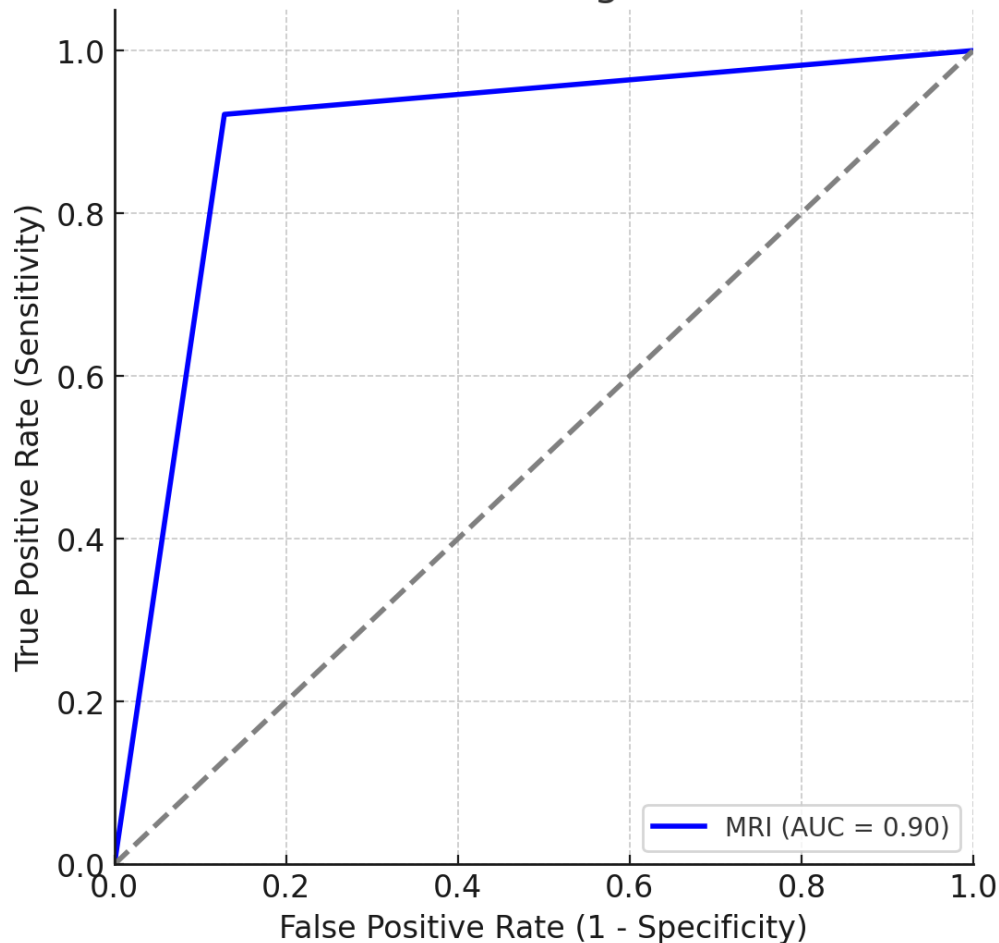


Figure 1 presents the receiver operating characteristic (ROC) curve for MRI in detecting endometrial carcinoma. The area under the curve (AUC) was 0.90, indicating excellent discriminatory ability of MRI in distinguishing malignant from non-malignant cases.

DISCUSSION

In this cohort of 227 women evaluated for suspected endometrial carcinoma, MRI achieved high diagnostic performance—sensitivity 92.1%, specificity 87.2%, PPV 85.5%, NPV 93.2%, and overall accuracy 89.9%—against histopathology as the gold standard. These figures indicate that, in our tertiary-care setting, MRI is a reliable non-invasive modality for detecting endometrial carcinoma and can meaningfully inform downstream management. Our sensitivity is broadly in the upper range of contemporary

reports and our specificity is consistent with pooled estimates for preoperative assessment.

Our sensitivity aligns with or exceeds several regional series. A Karachi tertiary-centre experience reported MRI sensitivity 95.8% and specificity 77.9% for deep myometrial invasion and 83.3%/80% for endocervical invasion; though focused on staging, it supports MRI's strong rule-in capability in local practice.^[8]

A separate Pakistani single-centre series reported sensitivity 92.9%, specificity 88.1%, and accuracy 89.3% for detecting cervical stromal invasion, similar to our study's overall accuracy.^[9] These local data—together with our findings—suggest MRI performs robustly in our context despite variations in equipment and protocols.

Internationally, recent meta-analyses comparing transvaginal ultrasound (TVUS) and MRI for deep myometrial invasion (DMI) report pooled MRI sensitivity around 0.81 and

specificity 0.84, with TVUS often similar in sensitivity but variably lower in specificity; our point estimates are slightly higher for sensitivity and comparable for specificity.^[5, 10] Moreover, a 2022 Clinical Radiology analysis of low-grade EC suggested MRI offered ~20% higher specificity than TVUS with similar sensitivity, underscoring MRI's advantage in ruling out extensive invasion.^[11] These patterns mirror our high NPV (93.2%), which is clinically useful when negative MRI could obviate immediate invasive procedures in selected patients.

Beyond conventional sequences, diffusion-weighted imaging (DWI) continues to strengthen MRI's role. A 2024 prospective BMC series showed excellent inter-observer reliability of ADC measurements and supported quantitative DWI to refine preoperative risk stratification.^[12] Meta-analytic work also indicates DWI can approach or complement dynamic contrast-enhanced MRI (DCE-MRI) for DMI assessment, with technique-level differences (e.g., reduced FOV vs. high-resolution methods) influencing accuracy.^[13, 14] Our study—deliberately non-contrast by protocol—still achieved accuracy within the range reported for multiparametric approaches, supporting the pragmatic value of T1/T2/DWI in resource-variable settings.

For cervical stromal invasion (CSI), pooled estimates show high specificity but only moderate sensitivity for MRI (~0.95 and 0.55, respectively), reflecting difficulty detecting subtle stromal breach [15]. Our higher sensitivity likely reflects a symptomatic cohort, protocol choices (consistent inclusion of DWI), and experienced readers; differences in prevalence and spectrum of disease also affect test characteristics. A very large 2025 multicentre analysis (n≈2,020) further showed MRI outperformed CT and was complementary to biopsy for CSI assessment, while emphasizing that image quality, tumor morphology, and reader expertise meaningfully modulate performance.^[16]

Rapid advances in radiomics are reshaping preoperative MRI utility. A 2025 systematic review reported pooled sensitivity 81% and specificity 91% for radiomics-augmented multiparametric MRI in assessing DMI,^[11] and a 2025 BMC Cancer study developed MRI-radiomics models that non-invasively predicted lymphovascular space invasion (LVSI), a key

prognostic factor typically known only after surgery.^[17] These developments suggest an evolving pathway in which standard sequences (including DWI) provide robust baseline detection—consistent with our results—while radiomics may add granular risk stratification and potentially reduce reliance on contrast or invasive staging in future workflows.

Strengths include (i) histopathology as the uniform reference standard; (ii) a relatively large, single-setting sample for Pakistan; and (iii) systematic handling of effect modifiers. The non-contrast protocol demonstrates real-world feasibility where contrast use may be constrained by availability, cost, or contraindications—yet still yielded high accuracy comparable to pooled literature for DMI and CSI.^[10, 12-14] Limitations include lack of inter-reader variability analysis, potential spectrum bias from a symptomatic cohort, and absence of systematic nodal assessment: DWI has shown promise for nodal metastasis with sensitivity ~81% and specificity ~89%, but remains imperfect and may benefit from hybrid techniques.^[18]

Clinical implications and future directions

Clinically, our high NPV (93.2%) supports the use of MRI to confidently exclude disease in select patients with equivocal sonography, potentially curbing immediate invasive sampling. High sensitivity and overall accuracy also support MRI-guided surgical planning, particularly in centres where frozen section is not routinely available. Looking ahead, standardizing non-contrast multiparametric protocols (T2/DWI) and incorporating validated radiomics signatures could further optimize accuracy while maintaining access and cost-effectiveness. Prospective multicentre studies in Pakistan comparing harmonized non-contrast MRI against TVUS (including 3D-TVUS, which meta-analyses suggest can match or exceed MRI for DMI and CSI in expert hands) are warranted to define modality sequencing and cost-utility in our health system.^[19, 20] Finally, constant technology updates and emerging data from oncology meetings reinforce MRI's expanding role across detection, subtyping, and treatment selection, which should be periodically reviewed to update local practice guidelines.^[21]

CONCLUSION

In this cross-sectional study of 227 women with suspected endometrial carcinoma, magnetic resonance imaging (non-contrast T1/T2 with DWI) demonstrated high diagnostic performance against histopathology, with sensitivity 92.1%, specificity 87.2%, PPV 85.5%, NPV 93.2%, and overall accuracy 89.9%. These findings support MRI as a reliable, non-invasive modality for detecting endometrial carcinoma in a Pakistani tertiary-care setting, with a particularly strong negative predictive value that can help confidently exclude disease and inform timely clinical decision-making.

Given its accuracy and feasibility without routine contrast administration, MRI can complement first-line assessments, refine preoperative planning, and potentially reduce unnecessary invasive procedures in selected patients. Future work should validate these results across multicentre cohorts, assess inter-reader agreement, and explore standardized non-contrast multiparametric protocols and radiomics-augmented models to further optimize diagnostic yield and cost-effectiveness in our context.

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Competing Interests / Rights

The authors declare no competing interests (financial or non-financial). No sponsor or third party had any role in study design, data collection, analysis, interpretation, manuscript preparation, or the decision to submit for publication. The authors retain full rights to the work and its publication and had unrestricted access to the data.

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