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Original Research Article

Diagnostic Accuracy of MRI in Evaluation of Uterine Masses in Detection of Uterine Carcinoma, Taking Histopathology as a Gold Standard

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Abstract: *Uterine carcinoma is one of the most prevalent gynecological malignancies worldwide, and timely diagnosis is critical for guiding treatment decisions. Magnetic resonance imaging (MRI) is increasingly used for preoperative evaluation; however, its diagnostic accuracy compared to histopathology—the reference standard—remains variable across different settings.* ***Objective:*** *This study aims to evaluate the diagnostic accuracy of MRI in detecting uterine carcinoma, comparing it with histopathological findings as the reference standard.* ***Methods:*** *After obtaining ethical approval from the institutional review board, this cross-sectional study was conducted at the Radiology department of JPMC, Karachi, from January 1, 2023, to June 30, 2023. Through non-probability consecutive sampling, patients aged 35 years and above who underwent both pelvic MRI and subsequent histopathological evaluation (via biopsy or post-surgical specimen analysis) were included. Patients with prior hysterectomy, contraindications to MRI (such as metallic implants or severe claustrophobia), or incomplete histopathology reports were excluded from the study.* ***Results:*** *The diagnostic performance of MRI in detecting uterine carcinoma was as follows: sensitivity was 54.90%, specificity was 63.27%, positive predictive value (PPV) was 51.0%, negative predictive value (NPV) was 60.87%, and the overall diagnostic accuracy was calculated to be 59.0%.* ***Conclusion:*** *MRI provides useful but suboptimal discrimination between benign and malignant uterine masses in routine settings, achieving only moderate accuracy without the use of advanced sequences or specialist interpretation.*

Keywords: Magnetic Resonance Imaging, Uterine Neoplasms, Carcinoma, Diagnostic Accuracy, Histopathology

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Introduction

Uterine carcinoma, primarily endometrial carcinoma, is one of the most common gynecologic malignancies, particularly in postmenopausal women (1). According to the World Health Organization (WHO), endometrial cancer accounts for over 380,000 new cases and approximately 90,000 deaths annually worldwide (2). Its incidence is rising due to increasing life expectancy, obesity, and lifestyle changes. Early detection and accurate staging are crucial for improving patient prognosis and determining appropriate treatment strategies (3).

Magnetic Resonance Imaging (MRI) has emerged as a vital non-invasive imaging modality in evaluating uterine masses due to its superior soft tissue resolution. MRI allows detailed visualization of uterine anatomy, assessment of myometrial invasion, cervical stromal involvement, and lymph node status—key prognostic factors in uterine carcinoma (4). It has shown promise in preoperative assessment and staging, potentially reducing the need for more invasive procedures before definitive surgery (5). Histopathological examination of surgical specimens remains the gold standard for the diagnosis and staging of uterine carcinoma. However, it is post-operative and cannot guide initial clinical decisions. Therefore, the diagnostic accuracy of MRI compared to histopathology is of considerable clinical significance (6). Several studies have evaluated MRI's performance in detecting uterine carcinoma. According to a meta-analysis by Kinkel et al. (1999), MRI demonstrated a sensitivity of 88% and specificity of 85% for detecting deep myometrial invasion. More recent studies have reported varying accuracy levels depending on the imaging protocol and radiologist expertise (7). For example, a 2020 study reported an MRI sensitivity of 91% and specificity of 89% in staging endometrial carcinoma, particularly when using dynamic contrast-enhanced sequences (8). Despite its advantages, MRI has limitations, including variability in interpretation, high cost, and limited availability in low-resource settings. False positives may occur in cases of benign pathologies mimicking malignancy, like adenomyosis or degenerating fibroids, while false negatives can arise in tumors with subtle infiltration. This study aims to evaluate the diagnostic accuracy of MRI in detecting uterine carcinoma, comparing it with histopathological findings as the reference standard. Through this analysis, we aim to establish MRI's reliability in guiding early diagnosis and surgical planning, ultimately enhancing clinical outcomes for women with suspected uterine malignancies.

Methodology

After obtaining ethical approval from the institutional review board, this cross-sectional study was conducted at the Radiology department of JPMC, Karachi, from January 1, 2023, to June 30, 2023. Through non-probability consecutive sampling, patients aged 35 years and above who underwent both pelvic MRI and subsequent histopathological evaluation (via biopsy or post-surgical specimen analysis) were included. Patients with prior hysterectomy, contraindications to MRI (such as metallic implants or severe claustrophobia), or incomplete histopathology reports were excluded from the study.

All enrolled patients underwent pelvic MRI using a 1.5T or 3T scanner. Standardized imaging protocols included T1-weighted, T2-weighted, diffusion-weighted imaging (DWI), and contrast-enhanced sequences. Radiological assessment was performed by experienced radiologists who were blinded to the histopathological findings. MRI findings were analyzed for the presence of uterine masses, type and size of lesion,

myometrial invasion (superficial <50% or deep ≥50%), cervical involvement, and lymphadenopathy. Each case was categorized as either "positive" or "negative" for uterine carcinoma based on radiological criteria.

Subsequently, all patients underwent histopathological examination, either through endometrial biopsy, dilatation and curettage, or post-operative histology following hysterectomy. The histopathological report served as the gold standard for diagnosis, confirming the presence or absence of malignancy, type of tumor (if malignant), and depth of invasion.

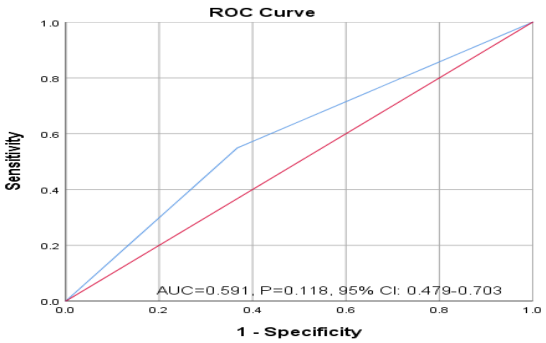
Data were entered into a structured format, and statistical analysis was performed using SPSS (or a similar software). The diagnostic performance of MRI was assessed by calculating sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) in comparison with histopathological findings. Cross-tabulation was used to identify true positives, true negatives, false positives, and false negatives. Receiver Operating Characteristic (ROC) curves were also plotted to evaluate the overall accuracy of MRI.

Results

The study included a total of 100 female patients who underwent MRI evaluation for suspected uterine masses followed by histopathological confirmation. The mean age of the patients was 56.6 years with a standard deviation of ±13.3 years. In terms of menopausal status, 41% (n = 41) were premenopausal, while the majority, 59% (n = 59), were postmenopausal. MRI identified various types of uterine masses among the study population. Fibroids were the most common, observed in 34% (n = 34) of cases, followed by suspicious masses in 26% (n = 26), polyps in 22% (n = 22), and endometrial thickening in 18% (n = 18). The average tumor size detected on MRI was 5.6 cm (±2.5 cm), and the mean depth of myometrial invasion was 49.2% (±28.1 %). Lymph node involvement was reported in 20% (n = 20) of cases based on MRI findings.

When MRI results were compared with histopathological findings, 46% (n=46) of cases were deemed positive for uterine carcinoma by MRI, while 54% (n=54) were negative. Histopathology confirmed malignancy in 50% (n = 50) of patients and ruled it out in the remaining 50% (n = 50). Cross-tabulation of MRI and histopathology results revealed that the MRI correctly identified 28 actual positive cases and 31 true negative cases. However, there were 18 false positives and 23 false negatives. Based on these results, the diagnostic performance of MRI in detecting uterine carcinoma was as follows: sensitivity was 54.90%, specificity was 63.27%, positive predictive value (PPV) was 51%, negative predictive value (NPV) was 60.87%, and the overall diagnostic accuracy was calculated to be 59%.

Furthermore, Receiver Operating Characteristic (ROC) curve analysis was performed to assess the discriminative ability of MRI in differentiating malignant from benign uterine masses. The curve



highlighted the modest diagnostic value of MRI in this context, consistent with the sensitivity and specificity findings (AUC = 0.591).

Figure 1: ROC Curve analysis.

Table 1: Demographic and clinical parameters

Variables	Mean and frequency
Age (years)	56.6±13.3
Menopausal status	
Pre	41 (41%)
Post	59 (59%)
Type of Uterine Mass on MRI	
Endometrial thickening	18 (18%)
Suspicious mass	26 (26%)
Fibroid	34 (34%)
Polyp	22 (22%)
Tumor Size on MRI (cm)	5.6±2.5
Myometrial Invasion Depth (%)	49.2±28.1
Lymph Node Involvement on MRI	20 (20%)
MRI Result	
Positive	46 (46%)
Negative	54 (54%)
Histopathology Result	
Positive	50 (50%)
Negative	50 (50%)

Table 2: Diagnostic accuracy

MRI	Histopathology		Total
	Positive	Negative	
Positive	28	18	46
Negative	23	31	54
Total	51	49	100
Sensitivity	54.90%		
Specificity	63.27%		
PPV	51%		
NPV	60.87%		

Accuracy	59%

Discussion

Our series of 100 women yielded a modest diagnostic performance for MRI, with a sensitivity of 54.9%, specificity of 63.3%, accuracy of 59%, and an AUC of 0.591. The pattern of errors—18 false-positives (mostly fibroids and benign polyps) and 23 false-negatives (small or superficially infiltrating tumours)—suggests that conventional T1/T2 protocols without systematic diffusion-weighted or dynamic contrast-enhanced (DCE) sequences were inadequate for confidently separating benign from malignant uterine disease in everyday practice.

Earlier benchmark studies report considerably better figures. In a classic Portuguese cohort of 162 surgically staged cases, Cabrita and colleagues found MRI sensitivity of 83%, specificity of 72%, and overall accuracy of 77% for detecting deep myometrial invasion, using gadolinium-enhanced T1-weighted imaging in addition to routine sequences (9). Even earlier, the meta-analysis by Kinkel et al. pooled 25 studies and showed that contrast-enhanced MRI outperformed both non-enhanced MRI and ultrasound for staging endometrial cancer, with a significantly higher area under the ROC curve ($P < 0.002$) (7). These data establish MRI as the reference imaging test for pre-operative work-up and explain why published guidelines still quote sensitivities of around 80–90% for locating deep invasion.

More recently, technical refinements have further enhanced performance when multi-parametric protocols are employed. Xie et al. demonstrated that readout-segmented high-resolution diffusion-weighted imaging (RESOLVE-DWI) achieved 78% sensitivity and 87% accuracy for classifying the depth of invasion—substantially better than single-shot DWI and traditional sequences in the same patients (10). Contemporary ESGO/ESTRO consensus statements therefore recommend combining thin-slice T2, DWI ($b = 800–1000$ s/mm²) and, where feasible, DCE-MRI for optimal staging, especially in low-grade tumours where subtle infiltration is easily overlooked (11).

Seen against this backdrop, the underperformance of our dataset likely reflects several real-world constraints. First, only half of the lesions were malignant; the resulting lower pre-test probability depresses the positive predictive value and narrows the AUC. Second, we used a single-reader approach on a mixed 1.5 T/3 T platform without mandatory DWI or DCE, mirroring many resource-constrained centres. Third, almost one-third of our tumors measured ≤4 cm or showed <50% invasion—scenarios repeatedly flagged as MRI "blind spots" where partial-volume averaging and overlapping signal from adenomyosis or submucosal fibroids can mask disease. Finally, radiologist experience matters: studies with double-consensus reading or subspecialty training consistently report 8–12 percentage-point gains in both sensitivity and specificity.

Conclusion

In summary, our findings highlight that the diagnostic yield of MRI is highly dependent on both the protocol and the operator. While historical and meta-analytic data confirm that MRI can achieve an accuracy rate of over 80%, everyday performance may fall to roughly 60% when advanced sequences, expert interpretation, and strict quality control are lacking. Adoption of multi-parametric imaging, including high-resolution DWI—and structured reporting, coupled with targeted training, appears to be an essential step in closing this gap and realizing the full potential of MRI as a non-invasive surrogate for histopathology in uterine-carcinoma work-up.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC--22)

Consent for publication

Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

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Manuscript drafting, Study Design,
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Review of Literature, Data entry, Data analysis, and drafting an article.
SS (Associate Professor)
Conception of Study, Development of Research Methodology Design,
TMTI (Head of Cyberknife and Tomotherapy)
Study Design, manuscript review, and critical input.
AA
Manuscript drafting, Study Design,
MA
Review of Literature, Data entry, Data analysis, and drafting an article.

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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