Original Article

An Observational Study of the Accuracy of MRI in Staging Endometrial Adenocarcinoma in a Tertiary Care Hospital

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Abstract

Background: Endometrial adenocarcinoma is the most common histological subtype of endometrial cancer. Accurate preoperative staging is essential for determining the extent of surgery and planning appropriate adjuvant treatment. Magnetic resonance imaging (MRI) is considered the imaging modality of choice for local staging because of its superior soft-tissue contrast and multiplanar capability. However, its diagnostic accuracy requires validation against histopathological examination, which remains the gold standard. Therefore, the present study aimed to evaluate the diagnostic accuracy of MRI in the preoperative staging of endometrial adenocarcinoma by comparing MRI findings with postoperative histopathological examination in patients treated at a tertiary care hospital. **Material and Methods:** This observational study included 50 consecutive patients with histopathologically confirmed endometrial adenocarcinoma who underwent preoperative pelvic MRI followed by definitive surgical management. MRI findings regarding tumor size, depth of myometrial invasion, cervical stromal involvement, serosal involvement, and pelvic nodal status were compared with postoperative histopathological findings. Diagnostic performance was assessed using sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy, with appropriate statistical evaluation methods. **Results:** The majority of patients were aged 51–60 years (38%) and were postmenopausal (74%). Grade I tumors constituted 64% of cases. MRI demonstrated good agreement with histopathology for tumor size and myometrial invasion. The overall diagnostic accuracy for superficial (<50%) and deep (>50%) myometrial invasion was 74% each. MRI showed excellent diagnostic performance for serosal involvement, with a sensitivity of 100%, specificity of 95.7%, NPV of 100%, and overall accuracy of 96%. For cervical stromal involvement, MRI demonstrated a sensitivity of 40%, specificity of 91.1%, and accuracy of 86%. Pelvic nodal involvement showed 100% sensitivity, 82.6% specificity, and 84% overall accuracy. MRI had consistently high negative predictive values for advanced disease, although positive predictive values for cervical stromal and nodal involvement were relatively low. **Conclusion:** MRI is a reliable, non-invasive modality for the preoperative staging of endometrial adenocarcinoma. It demonstrates high diagnostic accuracy for serosal involvement and good performance in assessing myometrial invasion, making it valuable for surgical planning. However, histopathological examination remains the gold standard because MRI has limited sensitivity for cervical stromal invasion and moderate specificity for pelvic nodal metastasis. Combining MRI findings with clinical and pathological assessment can improve treatment planning and patient outcomes.

Keywords: Endometrial adenocarcinoma, Magnetic resonance imaging, Histopathology, FIGO staging, Myometrial invasion, Cervical stromal involvement, Serosal involvement.

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Introduction

Endometrial carcinoma is the most prevalent gynecological cancer in developed countries. The incidence of this is on the rise in developing countries because of factors such as increased life expectancy, obesity, diabetes mellitus, and other lifestyle-related risk factors.[1] It mainly occurs in postmenopausal women, but approximately 20-25% of cases occur in premenopausal women. Endometrioid adenocarcinoma accounts for almost 80-90% of all endometrial cancers and tends to have a more favorable prognosis than other histological types of endometrial cancer, including serous and clear cell adenocarcinomas.[2] The diagnosis and staging of endometrial adenocarcinoma are important aspects of treatment planning, prognosis, and long-term survival. The International Federation of Gynecology and Obstetrics (FIGO) staging system for endometrial carcinoma is largely determined by surgery and pathological examinations. Some of the more important prognostic factors include depth of myometrial invasion, presence of cervical stromal involvement, presence of lymph node metastasis, adnexal extension, and extrauterine spread.[3] These factors impact the degree of surgical intervention, such as lymphadenectomy, sentinel lymph node biopsy, adjuvant radiotherapy, and chemotherapy. Thus, preoperative assessment

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is a crucial step in patient management and achieving optimal results that are specific to each individual. Magnetic Resonance Imaging (MRI), because of its exceptional soft-tissue contrast resolution and multiplanar imaging capability, has become the imaging modality of choice for the evaluation of endometrial carcinoma before surgery.[4] MRI has the advantage of providing detailed information about the depth of myometrial invasion, cervical stromal extension, serosal involvement, adnexal disease, and pelvic lymphadenopathy. MRI has the advantage of providing excellent tissue characterization without exposure to ionizing radiation, as compared with computed tomography (CT), and is especially useful in gynecologic oncology. The improved diagnostic accuracy of local staging by MRI has been further enhanced by incorporating diffusion-weighted imaging (DWI) and dynamic contrast-enhanced (DCE) sequences.[5] Evaluation of myometrial invasion is one of the most significant parts of MRI staging, as it directly corresponds to the risk of lymph node metastasis and disease recurrence. Patients with myometrial invasion of less than 50% usually have a lower risk of node involvement and may not require extensive lymph node dissection; deep myometrial invasion is linked to a much greater risk of metastatic disease.[6] Similarly, an accurate diagnosis of cervical stromal invasion can change the disease stage; therefore, the surgical strategy should be adjusted, highlighting the need for accurate imaging. The diagnostic accuracy of MRI for staging endometrial carcinoma has been evaluated in several studies, all of which have reported sensitivity ranging from 75% to 95% and specificity >85% for the detection of myometrial invasion and cervical involvement.[7] However, the accuracy of MRI can be affected by tumor size, degree of tissue organization (histological grade), the presence of coexisting adenomyosis or leiomyoma, imaging technique, radiologist experience, and the time between imaging and surgery. Therefore, institutional validation of MRI findings against postoperative histopathological examination is still required to obtain a true idea of its real-world diagnostic performance. Histopathological examination of surgical specimens remains the standard method for staging endometrial carcinoma. MRI results can be compared with the final histopathological staging and used to assess the sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy of MRI in detecting various disease stages.[8] This is extremely useful for optimizing preoperative planning and avoiding overtreatment and undertreatment. MRI is important for the full evaluation of patients with endometrial adenocarcinoma in tertiary care facilities with advanced imaging facilities and multidisciplinary oncology services. However, patient characteristics, disease presentation, and imaging interpretation all vary, requiring ongoing assessment of MRI performance in different healthcare environments. Therefore, the present observational study was undertaken to evaluate the accuracy of MRI in the preoperative staging of endometrial adenocarcinoma by comparing MRI findings with postoperative histopathological staging in patients managed at a tertiary care hospital.

Materials and Methods

This prospective observational study was conducted in the Department of Surgical Oncology, MNJ Institute of Oncology and Regional Cancer Center, Hyderabad, Telangana, India. Institutional ethical approval was obtained for the study with registration number 21617001001D; the period of study was from October 2022 to October 2024 for a period of 2 years. Written informed consent was obtained from all the participants of the study after explaining the nature of the study and possible outcomes in the vernacular language.

Inclusion Criteria

1. All patients with biopsy-proven endometrial adenocarcinoma during the duration of the study
2. Those who are willing to participate in the study.

Exclusion Criteria

1. Patients with advanced disease requiring chemotherapy before surgery were excluded.
2. Patients with histopathology other than endometrial carcinoma, such as carcinosarcoma and leiomyosarcoma, were excluded.
3. Those who are not willing to participate in the study.

All patients with a diagnosis of primary endometrial adenocarcinoma on biopsy without any other detected systemic metastasis were considered as candidates for recruitment into the study. Once recruited, patients were assigned a unique ID, and additional patient details were kept confidential. A dedicated MRI protocol was followed for 50 consecutive cases of biopsy-proven endometrioid adenocarcinoma of the endometrium who underwent MRI Pelvis with abdominal screening with a 1.5 Tesla (T) MRI magnet. Imaging was performed after 3 hours fasting to reduce bowel peristalsis and 1 hour after voiding for a partially filled urinary bladder. The MRI sequences performed included high resolution T2 weighted imaging (T2WI) in 3 orthogonal planes (axial, sagittal and coronal) tilted to the uterine cavity with follow up fat saturated T2 weighted images (T2WI), and T1 weighted imaging (T1WI) in axial and sagittal planes with pre and post fat suppressed T1 Fast Spin Echo (FSE) (after gadolinium administration 0.1 mmol/kg body weight) and diffusion weighted imaging (DWI). MRI parameters of tumour size, disease limited to the endometrium, superficial myometrial invasion, deep myometrial invasion, and cervical stromal involvement were noted. Enlarged pelvic and paraaortic nodes were identified as being greater than 10 mm in Short Axis Diameter (SAD). According to the 2009 Revised FIGO Classification, patients were staged.

All patients underwent a comprehensive surgical staging with peritoneal fluid cytological examination, Robotic / Laparoscopic/ Open Extra fascial Hysterectomy with Bilateral Salpingo-Oophorectomy and Bilateral Pelvic Lymph Nodal Dissection ± Para-Aortic LN Dissection. Patients with obvious cervical stromal involvement were posted for Type II Radical hysterectomy instead of Type I Extra fascial hysterectomy. MRI findings were compared with final histopathology for concurrence on tumour size, depth of myometrial invasion, presence of adnexal, nodal and cervical stromal involvement

Statistical analysis: All the available data were uploaded to an MS Excel spreadsheet for analysis. The data were analyzed by

SPSS version 21 in Windows format. The continuous variables were denoted by mean and standard deviation. Categorical variables were denoted by frequency and percentages. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV), as well as the accuracy, were calculated by building a contingency table. The values of p (<0.05) were considered significant.

Results

[Table 1] presents the demographic and clinicopathological characteristics of the study population. The cohort comprised 50 patients with endometrial adenocarcinoma. The majority of patients belonged to the 51–60 years age group (38%), followed by 41–50 years (26%) and 61–70 years (24%). Only 8% of patients were aged 31–40 years, while 4% were older than 71 years. Most patients were postmenopausal (74%), whereas 26% were premenopausal. Histopathological grading revealed that Grade I tumors were the most common (64%), followed by Grade II (22%) and Grade III (14%). Lymphovascular space invasion was identified in only 10% of patients, while it was absent in the remaining 90%, indicating that the majority of tumors were low-grade lesions without lymphovascular invasion.

Table 1: Demographic and Clinical Characteristics of the Study Population (N=50)

Characteristic	Category	Frequency (n)	Percentage (%)
Age Group	31 — 40 years	4	8%
	41 — 50 years	13	26%
	51 — 60 years	19	38%
	61 — 70 years	12	24%
	> 71 years	2	4%
Menopausal Status	Postmenopausal	37	74%
	Premenopausal	13	26%
FIGO Grade (HPE)	Grade I	32	64%
	Grade II	11	22%
	Grade III	7	14%
Lymphovascular Invasion (HPE)	Present	5	10%
	Absent	45	90%

[Table 2] compares MRI findings with the final histopathological examination (HPE) for various tumor characteristics. Tumor size distribution was comparable between MRI and histopathology. MRI classified 54% of tumors as measuring 2.1–5 cm, compared with 58% on histopathology, while tumors larger than 5 cm constituted 30% and 28%, respectively. MRI identified 60% of patients as having less than half myometrial invasion, whereas histopathology demonstrated this finding in 66% of cases. Deep myometrial invasion (>50%) was reported in 40% of patients on MRI and 34% on histopathology. Cervical stromal involvement was detected in 12% of patients on MRI compared with 10% on histopathology. Similarly, MRI demonstrated serosal involvement in 10% of patients, whereas histopathology confirmed serosal invasion in 6%. Pelvic lymph node positivity was overestimated by MRI, with 24% reported as positive compared to only 8% confirmed on histopathology.

Table 2: Comparison of MRI and Histopathological Findings for Tumor Characteristics

Parameter	Category	MRI (n=50)	Percentage	HPE (n=50)	Percentage
Tumor Size	< 2.0 cm	8	16%	7	14%
	2.1 - 5 cm	27	54%	29	58%
	> 5 cm	15	30%	14	28%
Depth Of Myometrial Invasion	< 1/2	30	60%	33	66%
	> 1/2	20	40%	17	34%
Cervical Stromal Involvement	Present	6	12%	5	10%
	Absent	44	88%	45	90%
Serosal Involvement	Present	5	10%	3	6%
	Absent	45	90%	47	94%
Pelvic Nodal Status	Positive	12	24%	4	8%
	Negative	38	76%	46	92%

[Table 3] depicts the diagnostic performance of MRI in assessing the depth of myometrial invasion. For identifying less than half myometrial invasion, MRI demonstrated a sensitivity of 75.7%, specificity of 70.7%, positive predictive value (PPV) of 83.3%, negative predictive value (NPV) of 60.0%, and an overall diagnostic accuracy of 74.0%. For predicting greater than half myometrial invasion, MRI showed a sensitivity of 70.5%, specificity of 73.5%, PPV of 60.0%, NPV of 83.3%, and an overall accuracy of 74.0%. These findings indicate moderate diagnostic performance of MRI in assessing the depth of myometrial invasion.

Table 3: Diagnostic Performance of MRI in Predicting Depth of Myometrial Invasion

Parameter	< 1/2 Myometrial Invasion	> 1/2 Myometrial Invasion
True positive (TP)	25	12
False positive (FP)	5	8
False Negative (FN)	8	5
True Negative (TN)	12	25
Sensitivity	75.70%	70.50%
Specificity	70.70%	73.50%
Positive Predictive Value (PPV)	83.30%	60.00%
Negative Predictive Value (NPV)	60.00%	83.30%
Overall Accuracy	74.00%	74.00%

[Table 4] demonstrates the diagnostic performance of MRI for predicting serosal involvement, cervical stromal invasion, and pelvic nodal involvement. MRI achieved 100% sensitivity, 95.7% specificity, and 96% overall accuracy for detecting serosal involvement, with an excellent NPV of 100%, indicating a high ability to exclude serosal invasion when MRI findings were negative. For cervical stromal involvement, MRI demonstrated a relatively low sensitivity of 40% but a high specificity of 91.1%, resulting in an overall accuracy of 86%. The low PPV (33.3%) suggests that positive MRI findings for cervical stromal invasion should be interpreted cautiously. MRI also showed 100% sensitivity for detecting pelvic nodal involvement, with 82.6% specificity and an overall diagnostic accuracy of 84%. However, the PPV remained low (33.3%), reflecting a considerable number of false-positive nodal assessments despite excellent negative predictive performance.

Table 4: Diagnostic Performance of MRI in Predicting Serosal, Cervical, and Pelvic Involvement

Parameter	Serosal Involvement	Cervical Stromal Involvement	Pelvic Nodal Involvement
True Positive (TP)	3	2	4
False Positive (FP)	2	4	8
False Negative (FN)	0	3	0
True Negative (TN)	45	41	38
Sensitivity	100%	40%	100%
Specificity	95.70%	91.10%	82.60%
Positive Predictive Value (PPV)	60%	33.30%	33.30%
Negative Predictive Value (NPV)	100%	93.10%	100%
Overall Accuracy	96%	86%	84%

[Table 5] provides a summary of the overall diagnostic accuracy of MRI across the major staging parameters of endometrial adenocarcinoma. MRI demonstrated moderate accuracy (74%) for assessing both superficial and deep myometrial invasion. The highest diagnostic performance was observed for serosal involvement, with 100% sensitivity, 95.7% specificity, and 96% accuracy. MRI also showed excellent sensitivity and negative predictive value for pelvic nodal involvement but only moderate specificity due to false-positive findings. Cervical stromal involvement exhibited the lowest sensitivity (40%), although specificity remained high (91.1%). Overall, MRI proved to be highly reliable for ruling out advanced local disease because of its consistently high negative predictive values, while its ability to confirm positive findings, particularly cervical and nodal involvement, was comparatively limited.

Table 5: Summary of MRI Diagnostic Accuracy for Key Staging Parameters

Parameter Assessed by MRI	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Depth of Invasion (< 1/2)	75.7	70.7	83.3	60	74
Depth of Invasion (> 1/2)	70.5	73.5	60	83.3	74
Cervical Stromal Involvement	40	91.1	33.3	93.1	86
Serosal Involvement	100	95.7	60.0	100.0	96
Pelvic Nodal Involvement	100	82.6	33.3	100.0	84

Discussion

The present study aimed to evaluate the diagnostic accuracy of magnetic resonance imaging (MRI) in the preoperative staging of endometrial adenocarcinoma by comparing MRI findings with postoperative histopathological examination (HPE). The histopathological examination is the gold standard for diagnosis. Accurate assessment of the extent of surgery and identification of patients who might require assessment of lymph nodes and planning for adjuvant therapy is essential for the correct staging. The results of the present study indicate that MRI has excellent overall diagnostic performance, but the accuracy of the MRI diagnosis differs with respect to each of the staging parameters. Most of the patients in this study were aged between 51 and 60, with almost 75% being in the postmenopause age group. The same age distribution has been reported in several previous epidemiologic studies. This can be explained by the fact that there is a higher incidence of endometrial cancer among women after menopause, attributable

to estrogen exposure and metabolic risk factors. [1,2] Histopathology showed that almost two-thirds of the study population had Grade I tumors, suggesting that the majority of patients had a well-differentiated disease which typically has a favourable prognosis and a low rate of nodal metastasis.[6]

Myometrial invasion continues to be one of the most important goals of pre-MRI as it is closely related to the presence of lymphovascular invasion and to the risk of lymph node metastasis and recurrence. The overall diagnostic accuracy of MRI in the present study was 74% for superficial (<50%) and deep (>50%) myometrial invasion, with sensitivities of 75.7% and 70.5%, respectively. Similar results were found by Frei et al,[7] who reported the sensitivity of MRI for the assessment of deep myometrial invasion to be about 74-85%. Similarly, Nougaret et al,[5] highlighted the need to use more recent MRI with diffusion-weighted imaging for improved evaluation of myometrial infiltration. However, they found that false diagnosis is still possible in cases of adenomyosis, leiomyomas, thin myometrium, or large exophytic tumors. The moderate negative predictive value of MRI in this study suggests that MRI is not always accurate in detecting deep invasion and therefore should be used in conjunction with clinical and histopathological risk factors.

MRI proved to be very successful in detecting serosal involvement with a 100% sensitivity and 95.7% specificity and a total diagnostic accuracy of 96%. This has been confirmed by others, such as Haldorsen et al,[8] who found that MRI is very useful for excluding advanced local disease due to its superior soft-tissue contrast resolution. In the current study, the perfect negative predictive value demonstrates that the true absence of serosal invasion is well predicted by MRI findings of the absence of serosal invasion, suggesting that conservative surgical planning in appropriate patients is supported by this MRI finding. Although there has been improvement in MRI technology, evaluating cervical stromal invasion continues to be a challenge. The specificity of the MRI was high (91.1%), and the sensitivity was relatively low (40%), meaning that positive MRI tests were rare, but some patients with microscopic cervical stromal involvement did not have a positive MRI. Other studies have found MRI to have similar drawbacks, however, since MRI is more useful in ruling out cervical invasion than confirming it,[9] and microscopic stromal invasion cannot be clearly visualized in early-stage disease. Therefore, any MRI abnormality of the cervical spine needs to be taken with a pinch of salt and matched with the pathological findings.

A surprising finding in this study was the overestimation of the MRI for pelvic nodal involvement. MRI demonstrated 100% sensitivity and a negative predictive value of 100%, but the specificity was 82.6% and the positive predictive value was only 33.3%, indicating a substantial number of false-positive nodal assessments. This means that if enlarged lymph nodes are seen on the MRI, this does not necessarily mean that they are metastatic, since they can also appear enlarged due to reactive inflammatory changes which can resemble malignant disease. A similar finding was observed by Rockall et al,[10] who reported that using size alone for the assessment of nodes is not specific; while some normal-sized nodes can contain metastases, some enlarged nodes are not. The results of this study support the present guidelines to use imaging data in addition to sentinel lymph node mapping or surgical nodal evaluation as indicated. Close agreement was also found between MRI and histopathological measurements, both in terms of tumor size and comparison of the two methods (MRI vs histopathological). Accurate tumour size estimation aids surgical planning and aids in complete staging. Beddy et al,[11] compared MRI and histopathology for the assessment of the extent of endometrial carcinoma, and found a comparable degree of concordance. In summary, the results of the present study confirm the value of MRI for preoperative staging of the disease associated with endometrial adenocarcinoma. Very high diagnostic value was obtained for serosal involvement and good for myometrial invasion, with excellent NPVs for advanced disease. However, there are problems in the diagnosis of microscopic invasion of the cervix and the distinction of metastatic from reactive pelvic lymph nodes. Thus, MRI should be seen as an integral part of a multi-modality staging procedure and not as an alternative to histopathological assessment. More comprehensive and focused future studies, with larger patient populations, multicenter centers, and a standardized MRI protocol using advanced diffusion and functional imaging studies, may further refine staging accuracy and clinical decision-making.

Conclusion

Within the limitations of the current study, the results showed that MRI is a valuable non-invasive imaging modality for the preoperative staging of endometrial adenocarcinoma. It demonstrates a good overall agreement with histopathological findings. It showed excellent diagnostic accuracy for detecting serosal involvement and reliably excluded advanced disease owing to its high negative predictive value. MRI exhibited moderate accuracy in assessing the depth of myometrial invasion, an important prognostic factor influencing surgical management. However, its sensitivity for cervical stromal involvement and positive predictive value for pelvic nodal metastasis were comparatively lower. Therefore, while MRI may act as an indispensable tool for preoperative planning, histopathological examination remains the gold standard for definitive staging and treatment decision-making.

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Conflicts of interest

There are no conflicts of interest.

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