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Original Research Article

Assessing the Diagnostic Accuracy of MRI Imaging in Comparison to Histopathology in Endometrial Carcinoma: A Retrospective Observational Study

Anjali[1], Shobha K[2], Pallavi V R[3], Rajshekhar S K[4], Sumangala Gali[5]

[1]Mch resident, Department of Gynaecology oncology, Kidwai memorial institute of oncology, Bangalore, India

[2]Professor & HOD Department of Gynaecology oncology, Kidwai memorial institute of oncology, Bangalore, India

[3]Professor, Department of Gynaecology oncology, Kidwai memorial institute of oncology, Bangalore, India

[4]Associate professor, Department of Gynaecology oncology, Kidwai memorial institute of oncology, Bangalore, India

[5]Assistant professor, Department of Gynaecology oncology, Kidwai memorial institute of oncology, Bangalore, India

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Corresponding Author: Dr. Anjali

Conflict of interest: Nil

Abstract:

Background: Accurate preoperative staging is critical in the management of endometrial carcinoma to guide the extent of surgical intervention and reduce morbidity. Magnetic resonance imaging (MRI) is widely utilized for assessing key pathological features such as myometrial invasion, cervical stromal involvement, lymph node metastasis, and extra-uterine spread.

Aim: This study aimed to evaluate the diagnostic accuracy of MRI compared to histopathology in staging endometrial carcinoma.

Methods: A retrospective observational study was conducted on 100 women with biopsy-proven endometrial carcinoma who underwent preoperative MRI and surgical staging at a tertiary oncology center between January 2022 and September 2024. MRI findings were compared with final histopathological reports to determine sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and area under the receiver operating characteristic (ROC) curve (AUC) for each parameter.

Results: MRI demonstrated moderate diagnostic accuracy for myometrial invasion (sensitivity: 62.2%, specificity: 67.3%, AUC: 0.647). High specificity (99.81%) and NPV (98.68%) were observed for lymph node metastasis, with an AUC of 0.795. Cervical stromal invasion was detected with fair accuracy (sensitivity: 47.4%, specificity: 99.88%, AUC: 0.675). MRI showed limited diagnostic performance for detecting serosal breach and extra-serosal spread.

Conclusion: MRI is a valuable tool for preoperative evaluation, particularly for excluding lymph node and cervical stromal involvement. However, its limited sensitivity in detecting myometrial and extra-uterine spread warrants the integration of imaging with clinical and histopathological findings to optimize surgical decision-making.

Keywords: Diagnostic accuracy, Endometrial carcinoma, Lymph node metastasis, Magnetic resonance imaging, Myometrial invasion.

Introduction

Endometrial carcinoma is one of the most common gynecological malignancies worldwide and represents the predominant cancer of the female genital tract in high-income nations. As per GLOBOCAN 2022, the global incidence of endometrial cancer stands at approximately 28.0 per 100,000 women annually, with a mortality rate of 5.2 per 100,000 women [1]. Although early-stage disease is often diagnosed due to clinical symptoms such as abnormal uterine bleeding, accurate preoperative assessment remains essential to determine disease extent and tailor surgical intervention appropriately. Standard treatment includes total abdominal hysterectomy (TAH) with bilateral salpingo-oophorectomy (BSO), complemented by pelvic and para-aortic

lymphadenectomy depending on individual risk factors and histologic subtype [2].

Histopathological examination remains the gold standard for definitive diagnosis and staging, providing key information on the depth of myometrial invasion, cervical stromal involvement, tumor grade, lymph node status, and extra-uterine spread [3]. However, performing full surgical staging in all cases may result in overtreatment, increased operative time, and added morbidity. This is particularly important in elderly or comorbid patients, where extensive surgical dissection may not be feasible. Hence, reliable non-invasive imaging tools are needed to preoperatively identify high-risk features and guide the extent of surgical intervention.

Magnetic resonance imaging (MRI) is increasingly recognized as the preferred imaging technique based on its unique ability to provide excellent soft tissue contrast. MRI can provide important information prior to surgery about tumor size, depth of myometrial and cervical invasion, lymph node involvement, and presence of serosal or peritoneal spread [4]. The American College of Radiology (ACR) and European Society of Urogenital Radiology (ESUR) currently recommend MRI as the modality of choice for the local staging of endometrial carcinoma [5]. Further advances in MRI technologies, such as diffusion-weighted imaging (DWI) and dynamic contrast-enhanced sequences have improved diagnostic accuracy.

However, as a modality, MRI has limitations. Possible difficulties with interpretation may occur in postmenopausal women due to uterine atrophy, or because of uterine fibroids, adenomyosis, or polypoid tumors which may obscure tumor margins or simulate those edges. Sensitivity and specificity in the literature appears to vary for such things as myometrial invasion or microscopic cervical involvement [6,7]. Therefore, there is a need for ongoing assessment of the diagnostic accuracy of MRI in a variety of clinical settings.

The current retrospective observational study is designed to compare the diagnostic performance of MRI against histopathology for the staging of endometrial carcinoma. The study will look at sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and area under the ROC curve (AUC) of MRI for myometrial invasion, cervical stromal invasion, lymph node metastasis, serosal involement and extra-peritoneal spread. The results will hopefully have an impact on clinical practice usefulness and the basis for evidence-based guidelines for preoperative imaging in endometrial cancer.

Methodology

Study Design

This was a retrospective observational study conducted in the Department of Gynecologic Oncology at Kidwai Memorial Institute of Oncology, Bengaluru.

Study Population

The data was retrieved from hospital records and imaging archives. A record of pertinent clinical, radiological, and histopathological details, such as patient demographics, diagnosis confirmed via biopsy, MRI report, surgical staging information, and final histopathology report was made during the study.

Sample Size

The study included a total of 100 female patients diagnosed with endometrial carcinoma between January 2022 and September 2024. Institutional ethical clearance was obtained prior to commencement of the study.

Inclusion & Exclusion Criteria

Inclusion Criteria

- Women with biopsy-proven endometrial carcinoma.
- Patients who underwent both preoperative MRI and surgical staging procedures at our institute.

Exclusion Criteria

- Patients who had MRI or surgical treatment performed at external institutions.
- Patients with incomplete surgical staging or inadequate imaging data.

MRI Protocol

All MRI scans were performed using a 1.5 Tesla Philips Achieva MRI scanner. Patients were scanned in the supine position with partially filled bladders. To minimize bowel peristalsis and associated motion artifacts, patients were advised to fast for 6–8 hours prior to imaging.

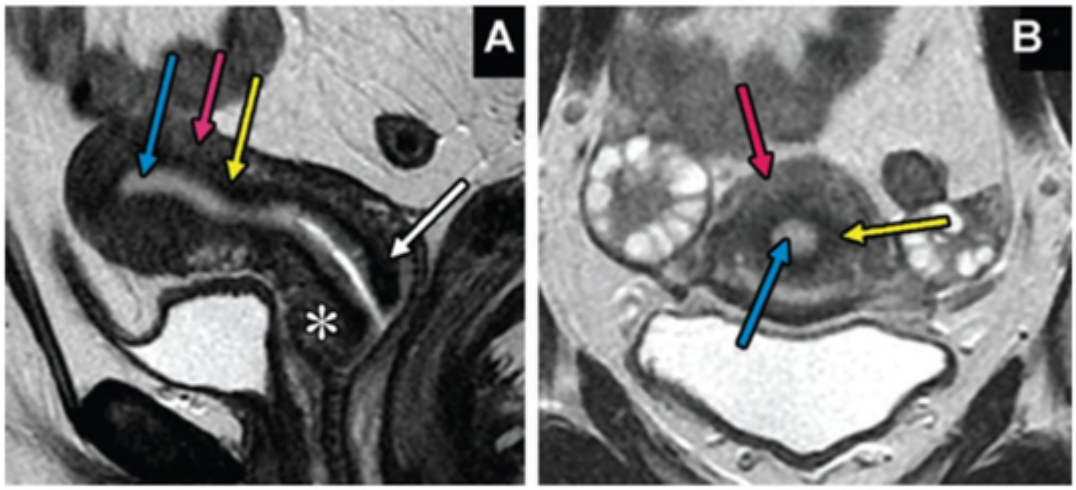


Figure 1. Normal anatomy of endometrium myometrium and junctional zone on MRI

Imaging Sequences

- **T2-weighted imaging (T2WI):** Axial, axial oblique, and sagittal planes using fast spin-echo sequences.
- **T1-weighted imaging (T1WI):** Axial Pre-contrast sequences.
- **Diffusion-weighted imaging (DWI):** Multiple b-values were applied to assess tissue diffusivity.
- **Dynamic post-contrast imaging:** Acquired following intravenous injection of gadopentetate dimeglumine (Magnevist) at a dose of 1.5 ml/kg body weight.

Image Interpretation

MRI scans were interpreted by experienced radiologists blinded to histopathological findings. Initial assessment involved unenhanced T1- and T2-weighted sequences, where tumors typically appeared as intermediate signal intensity on T2WI.

- **Myometrial invasion (MI)** was suspected when disruption of the hypointense junctional zone was observed.
- **Cervical stromal involvement** was evaluated using delayed post-contrast sequences, with loss of the normal hypointense cervical stroma indicating invasion.
- **Serosal involvement and extraserosal spread** were assessed based on bulging of tumor contours beyond the uterine serosa or evidence of adjacent organ infiltration.

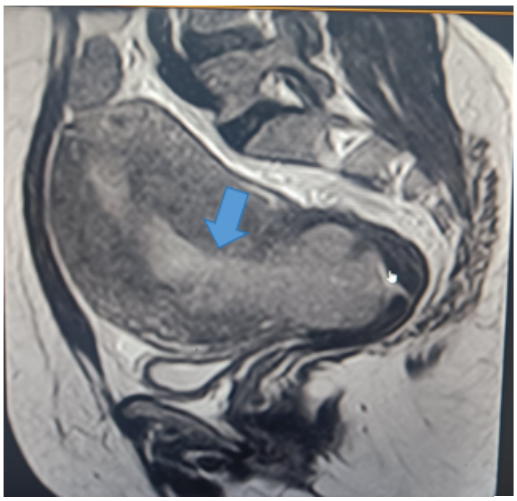


Figure 2. T2W sagittal view showing Intermediate signal intensity endometrium growth involving the cervix

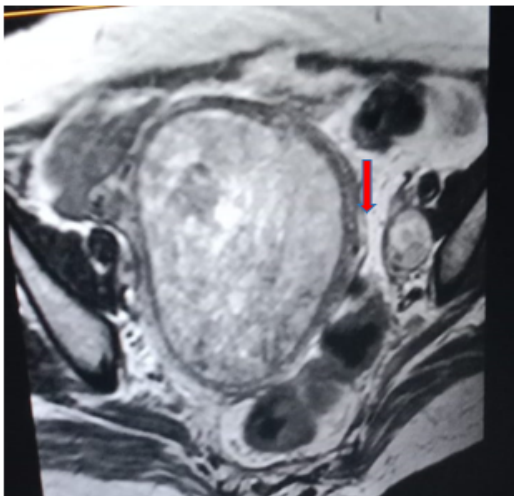


Figure 3. T2W axial view showing Intermediate signal intensity endometrium growth with serosal breach with metastatic external iliac lymph node

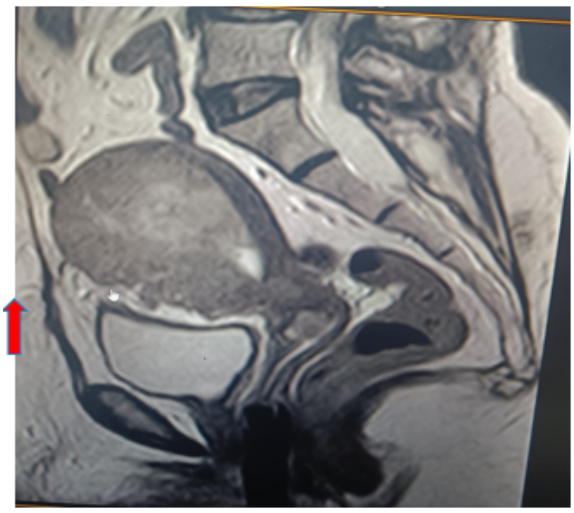


Figure 3. T2W saggital view showing Intermediate signal intensity endometrium growth with serosal breach on anterior wall of uterus and cervical involvement

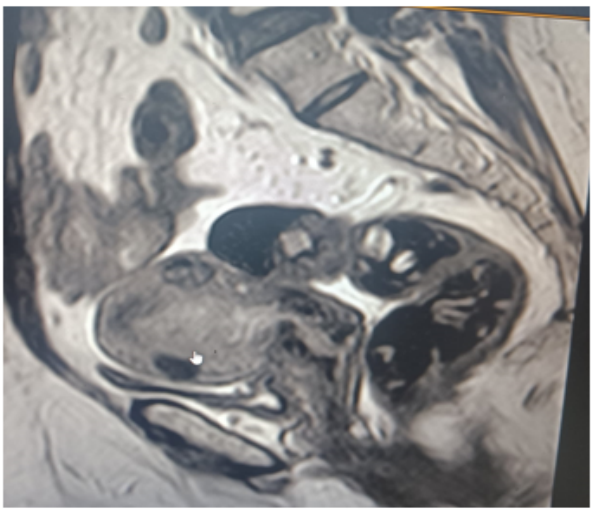


Figure 4. T2W saggital view showing Intermediate signal intensity endometrium growth with myometrial invasion with intramural fibroid making it difficult to accurately determine the extend

- **Lymph node metastasis** was evaluated based on criteria such as short-axis diameter ≥1 cm, spherical shape, irregular contour, central necrosis, and homogeneous contrast enhancement (excluding necrotic areas). Nodes were examined in relation to major pelvic and para-aortic vessels.

Statistical Analysis

All collected data were entered and analyzed using IBM SPSS Statistics software, version 25.0. The diagnostic performance of preoperative MRI was evaluated by comparing imaging findings with the final histopathology results, which served as the gold standard. For each parameter assessed—myometrial invasion, deep cervical stromal invasion, lymph node metastasis, serosal involvement, and extraserosal spread—key validity metrics were computed. These included sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy. The statistical evaluation aimed to determine the concordance between MRI-based staging and histopathological outcomes. A p-value of less than 0.05 was considered statistically significant, and results were interpreted in the context of their clinical relevance for preoperative decision-making.

Results

This retrospective analysis included 100 patients with histologically confirmed endometrial carcinoma. The diagnostic performance of preoperative magnetic resonance imaging (MRI) was systematically assessed by comparing imaging findings with final histopathological outcomes for key staging parameters, including myometrial invasion, cervical stromal involvement, lymph node metastasis, serosal breach, and extra-serosal spread.

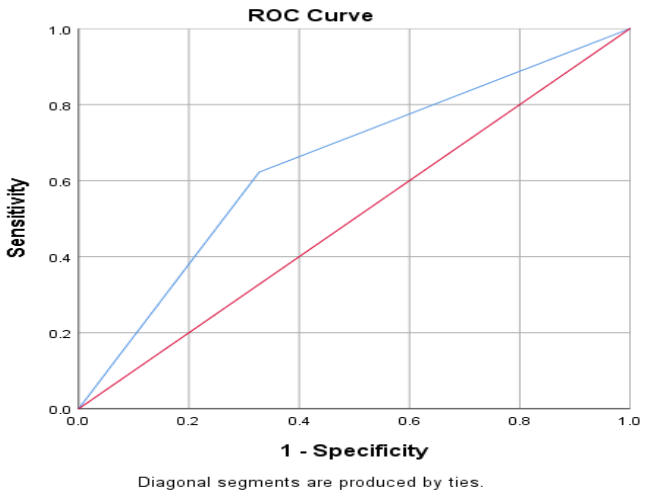
Table 1 presents the baseline characteristics of the 100 women included in the study with biopsy-proven endometrial carcinoma. The median age of participants was 56.5 years, ranging from 27 to 83 years, majority were postmenopausal (80%), while 20% were premenopausal. The mean parity was 1.69 ± 0.93, with a range of 0 to 4. Regarding the surgical approach, most patients underwent laparoscopy (57%), followed by robotic surgery (32%) and open procedures (11%). In terms of tumor histology, endometrioid carcinoma was the predominant subtype, observed in 80% of patients. The remaining 20% included serous carcinoma (8%), carcinosarcoma (6%), clear cell carcinoma (2%), mixed carcinoma (2%), and undifferentiated and poorly differentiated carcinomas (1% each). Among the endometrioid carcinoma cases (n = 80), Grade II tumors were most common (50%), followed by Grade I (27.5%) and Grade III (22.5%), indicating a predominance of low grade differentiated tumors in the cohort.

Table 1: Baseline Characteristics of Study Participants (N = 100)	
Characteristic	**Value**
Age (years)	Median: 56.5 (Range: 27–83)
Menopausal Status	Premenopausal: 20 (20%)
	Postmenopausal: 80 (80%)
Parity	Mean ± SD: 1.69 ± 0.93 (Range: 0–4)
Route of Surgery	Laparoscopy: 57 (57%)
	Robotic: 32 (32%)
	Open: 11 (11%)
Tumor Histology	Endometrioid carcinoma: 80 (80%)
	Serous carcinoma: 8 (8%)
	Carcinosarcoma: 6 (6%)
	Clear cell carcinoma: 2 (2%)
	Mixed carcinoma: 2 (2%)
	Undifferentiated carcinoma: 1 (1%)
	Poorly differentiated carcinoma: 1 (1%)
Grade of Endometrioid Carcinoma (n = 80)	Grade I: 22 (27.5%)
	Grade II: 40 (50%)
	Grade III: 18 (22.5%)

Table 2 summarizes the diagnostic performance of MRI compared to histopathological findings in evaluating key parameters of endometrial carcinoma among 100 patients. For myometrial invasion, MRI demonstrated a sensitivity of 62.2% and specificity of 67.3%, with both the positive and negative predictive values (PPV and NPV) at 66.66%. The area under the curve (AUC) was 0.647, indicating moderate diagnostic accuracy. In assessing lymph node metastasis, MRI showed high specificity (99.81%) and NPV (98.68%), but lower PPV (29.16%), despite a relatively high sensitivity of 77.8%, yielding a strong AUC of 0.795. For cervical stromal invasion, MRI exhibited excellent specificity (99.88%) and an NPV of 87.65%, although the sensitivity and PPV were both low at 47.4% and 47.36%, respectively. The AUC for cervical stromal invasion was 0.675, reflecting fair discriminative capacity. These findings suggest that while MRI is highly specific and reliable in ruling out disease, especially for lymph node and cervical involvement, its sensitivity is limited for detecting microscopic invasion.

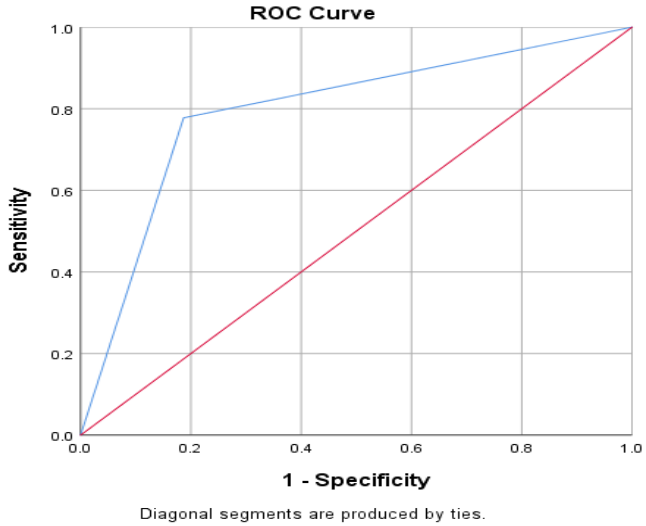
Table 2: Diagnostic Performance of MRI Compared to Histopathology in Endometrial Carcinoma (N = 100)								
Parameter	**MRI Finding**	**Histopathology Positive**	**Histopathology Negative**	**Sensitivity (%)**	**Specificity (%)**	**PPV (%)**	**NPV (%)**	**AUC**
Myometrial Invasion	≥50% invasion (n = 45)	30	15	62.2	67.3	66.66	66.66	0.647
	<50% invasion (n = 55)	15	40					
Lymph Node Metastasis	Involved (n = 24)	7	17	77.8	99.81	29.16	98.68	0.795
	Not involved (n = 76)	1	75					
Cervical Stromal Invasion	Involved (n = 19)	9	10	47.4	99.88	47.36	87.65	0.675
	Not involved (n = 81)	10	71					

Graph 1 presents the ROC curve represents the model's performance in predicting myometrial invasion. The blue line, which rises above the diagonal reference line (red), indicates that the model performs better than random guessing. The curve shows a moderate upward trend, suggesting the model has fair discriminative power to differentiate between patients with and without myometrial invasion. While the model is not highly accurate, it demonstrates acceptable sensitivity and specificity, indicating it could be useful as a preliminary diagnostic tool in clinical settings.



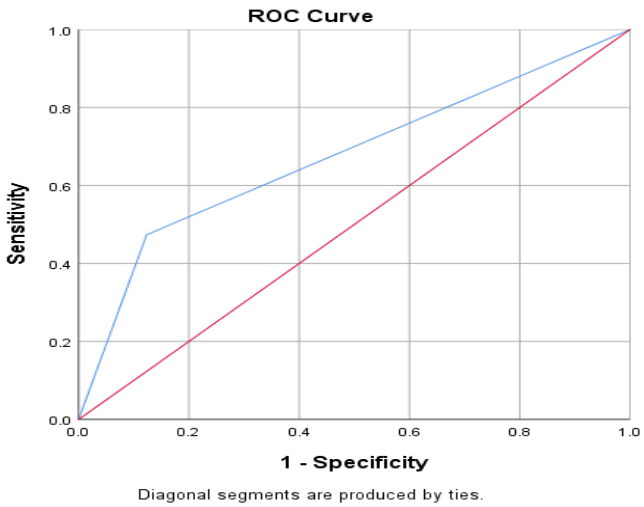
Graph 1: Myometrial Invasion

Graph 2 shows the ROC curve for MRI detection of lymph node metastasis demonstrates a steep rise in sensitivity at high levels of specificity, indicating excellent discriminative performance. The curve approaches the upper left corner of the plot, which represents perfect sensitivity and specificity. This is consistent with the calculated Area Under the Curve (AUC) of 0.795, suggesting good diagnostic accuracy of MRI in identifying lymph node involvement. The high specificity (99.81%) and high negative predictive value (98.68%) highlight MRI's reliability in ruling out lymph node metastasis. The relatively moderate sensitivity (77.8%) indicates that while MRI is highly effective at confirming negative cases, a small proportion of true positive cases may still be missed.



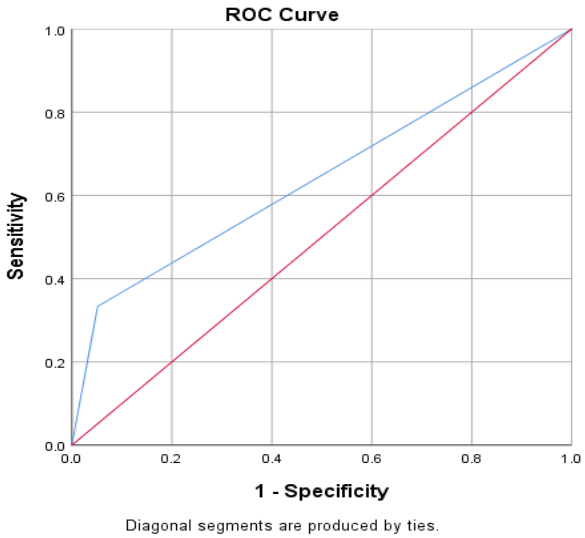
Graph 2: Lymph node

Graph 3 shows the ROC curve for cervical stromal invasion detection shows a moderate upward trend, reflecting a lower overall diagnostic accuracy compared to lymph node evaluation. The AUC value of 0.675 suggests fair but suboptimal discriminatory ability of MRI in detecting cervical stromal invasion. This aligns with the observed sensitivity of 47.4% and specificity of 99.88%. While the MRI is highly specific—meaning it performs well in confirming the absence of stromal invasion—the relatively low sensitivity indicates that a significant number of true cases with stromal invasion may be missed. This limited sensitivity is likely due to MRI's inability to detect microscopic cervical involvement, as previously supported by literature.



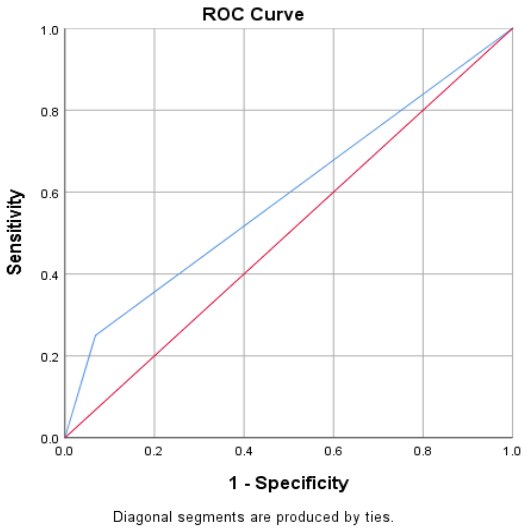
Graph 3: Cervical stromal invasion

Graph shows the ROC curve for serosal breech shows a performance that is closer to the diagonal line, suggesting limited discriminative ability. The proximity of the blue curve to the red reference line implies that the model's capability to correctly classify cases of serosal breech is only slightly better than random chance. This reflects low sensitivity and specificity, which raises concerns about the reliability of the model in predicting serosal breech. Overall, the model requires further refinement or additional clinical parameters to improve its predictive accuracy.



Graph 4: Serosal breech

Graph 5 illustrates the ROC curve used to assess the prediction of extra serosal spread, which is also near the diagonal, similar to graph 4. This indicates a pattern of poor model performance with poor sensitivity and specificity. The ROC curve indicates that the model had a very limited ability to distinguish the positive and negative cases of extra serosal spread and, due to its low diagnostic ability in this current form, the model may require restructuring or inclusion of more meaningful predictors to improve its use in clinical practice.



Graph 5: Extra serosal Spread

Discussion

This retrospective observational study sought to assess the diagnostic performance of magnetic resonance imaging (MRI) in recognizing key pathological characteristics of endometrial carcinoma by comparing preoperative MRI findings with the postoperative histopathological results from a cohort of 100 patients. The following parameters were examined: depth of myometrial invasion, cervical stromal involvement (i.e., stage IIC), lymph node metastasis, serosal invasion (i.e., stage IIIC), and extra-serosal spread. Diagnostic performance was evaluated using sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and area under the receiver operating characteristic (ROC) curve (AUC).

In our study, MRI demonstrated a sensitivity of 62.2%., specificity of 67.3%., and an AUC of 0.647 in the assessment of myometrial invasion, or a moderate level of diagnostic accuracy. The respective values for MRI are less than previous studies. For example, Goel et al. (2018) reported a sensitivity and specificity of 75% and 73% respectively with an overall accuracy of 74.14% [7]. Bi et al. (2020) a meta-analysis [6] reported a pooled sensitivity and specificity of 79% and 81% and Yu-Ting Huang et al. (2019) reported sensitivity of between 85-94% and specificity of 60-73% [8]. The overall diagnostic accuracy was relatively lower in the current study likely due to confounding factors including older patients (44% over 60 years), co-existent uterine fibroids (10%), adenomyosis (4%) and polyps (4%). These conditions were likely to distort uterine anatomy' and hinder the visualization of the junctional zone. However, MRI did provide excellent soft tissue resolution and was still useful in informing preoperative management decisions regarding surgical staging.

For lymph node metastasis, MRI had high diagnostic performance with sensitivity at 77.8%, specificity at 99.81%, and AUC at 0.795; a very high specificity and NPV of 98.68% demonstrates that MRI is useful in ruling out the presence of nodal disease. Yu-Ting Huang et al. (2019) had similar findings, listing their specificity between 90–99% [8] and sensitivity between 50–80% as well while Bi et al. (2020) reported a pooled specificity of 95% [6]. As for Goel et al. (2018), they recorded 66.67% sensitivity and 88.64% specificity—indicating the current study now has a greater level of diagnostic accuracy' in contrast to their study [7]. This discrepancy may be due to the full use of advanced radiological criteria when assessing metastatic involvement including nodal shape, contour irregularities, and central necrosis, which is much more than based on size assessment.

In contrast, MRI had limited value in identifying cervical stromal invasion in this study, with a sensitivity of 47.4% and specificity of 99.88%, with an AUC of 0.675 representing fair discrimination. The specificity and NPV (87.65%) suggest that MRI is a reliable test to exclude cervical invasion, however the low sensitivity indicates poor performance in detecting microscopic invasion. These results corroborate the existing literature, including the studies by Goel et al. (2018) as well as Bi et al. (2020), which emphasize MRI's limited sensitivity to detect subtle or early stromal invasive disease due to the spatial resolution limitations of this modality [7,6].

Additionally, the serosal breach and extra-serosal spread detected had the lowest diagnostic accuracy. ROC analysis of these parameters had curves 'that were almost on the reference diagonal line, meaning that the performance was only slightly better than chance. With respect to serosal breach detection, three patients were falsely positive on MRI but none of these was a false positive on histopathology. For

extra-serosal spread, only three of nine histologically confirmed cases were positive on MRI. Many of the undetected cases had serous histology which is known for an inclination towards early upper abdominal dissemination. MRI recognition of subtle peritoneal involvement is limited and these results endorse the recommendation for complete surgical staging of aggressive histologic subtypes, regardless of the radiologic findings.

In summary, the current study confirms that MRI as an adjunctive modality in evaluating endometrial carcinoma has a role in the staging process, specifically in determining lymph node involvement and ruling out cervical stromal invasion given its high negative predictive value and specificity. However, its moderate sensitivity to recognize myometrial invasion and its poor detection of serosal and extra-serosal spread limits definitive interpretation in imaging results. Clinicians should continue to integrate clinical, pathological, and imaging findings to continue accurate staging and surgical planning. More large-scale and prospective studies incorporating new high-level MRI protocols - for example, contrast-enhanced imaging sequences, sequential imaging, dynamic imaging and diffusion-weighted imaging- will be needed to increase diagnostic performance and clinical importance in endometrial cancer.

Conclusion

The present study underscores the role of MRI as an accurate tool in the pre-operative evaluation stage for lymph node metastasis and in ruling out cervical stromal invasion. MRI had high specificity and negative predictive value with respect to both clinical endpoints. However, the moderate sensitivity for myometrial invasion, as well as low sensitivity for serosal and extra-serosal spread, should remind us that no imaging modality is 100% accurate. The recognition of imaging, clinical, and histopathological parameters is important in the final assessment. Further prospective studies utilizing advanced imaging protocols are recommended to enhance the accuracy of preoperative evaluation and improve surgical planning.

References

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, Bray F. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA: a cancer journal for clinicians. 2021 May;71(3):209-49.
2. Concin N, Matias-Guiu X, Vergote I, Cibula D, Mirza MR, Marnitz S, Ledermann J, Bosse T, Chargari C, Fagotti A, Fotopoulou C. ESGO/ESTRO/ESP guidelines for the management of patients with endometrial carcinoma. International Journal of Gynecological Cancer. 2021 Jan 1;31(1):12-39.
3. Nair S. Histopathological Study of Hysterectomy Specimens in Uterus and Cervix (Doctoral dissertation, Rajiv Gandhi University of Health Sciences (India)).
4. Nougaret S, Horta M, Sala E, Lakhman Y, Thomassin-Naggara I, Kido A, Masselli G, Bharwani N, Sadowski E, Ertmer A, Otero-Garcia M. Endometrial cancer MRI staging: updated guidelines of the European Society of Urogenital Radiology. European radiology. 2019 Feb; 29:792-805.
5. Reinhold C, Ueno Y, Akin EA, Bhosale PR, Dudiak KM, Jhingran A, Kang SK, Kilcoyne A, Lakhman Y, Nicola R, Pandharipande PV. ACR appropriateness criteria® pretreatment evaluation and follow-up of endometrial cancer. Journal of the American College of Radiology. 2020 Nov 1;17(11):S472-86.
6. Bi Q, Chen Y, Wu K, Wang J, Zhao Y, Wang B, Du J. The diagnostic value of MRI for preoperative staging in patients with endometrial cancer: a meta-analysis. Academic Radiology. 2020 Jul 1;27(7):960-8.
7. Goel G, Rajanbabu A, Sandhya CJ, Nair IR. A prospective observational study evaluating the accuracy of MRI in predicting the extent of disease in endometrial cancer. Indian Journal of Surgical Oncology. 2019 Mar 6; 10:220-4.
8. Huang YT, Huang YL, Ng KK, Lin G. Current status of magnetic resonance imaging in patients with malignant uterine neoplasms: a review. Korean journal of radiology. 2019 Jan;20(1):18-33.