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DIAGNOSTIC ACCURACY OF DYNAMIC CONTRAST-ENHANCED MAGNETIC RESONANCE IMAGING AND DIFFUSION WEIGHTED IMAGING IN DIAGNOSIS OF ENDOMETRIAL CARCINOMA TAKING HISTOPATHOLOGY AS GOLD STANDARD

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ABSTRACT

Objective: To determine diagnostic accuracy of dynamic contrast-enhanced versus diffusion weighted imaging to diagnose myometrial invasion of endometrial carcinoma in females with histopathology was kept as gold standard.

Study design: Cross-sectiona1, validation study.

Study place & period: Department of Diagnostic Radiology GMC / Gujranwala Teaching Hospital Gujranwala from 15th August 2025 till 15th of October 2025.

Methodology: All females fulfilling the criteria were included in the study and were subjected to DEC-MRI and DWI-MRI before surgery. Eligible females underwent preoperative DCE- MRI and DWI-MRI to assess myometrial invasion. Findings for both modalities were noted. Then surgery was performed and biopsy samples were assessed for histopathology. Findings of histopathology were compared with DCE-MRI and DWI-MRI.

Results: In this study, we observed that the mean age of females was 60.25 ± 6.00 years. The mean BMI was 27.86 ± 4.42 kg/m2. The DCE-MRI had Sensitivity: 92.2%, specificity: 95.2%, PPV: 92.2%, NPV: 95.2%, accuracy: 94.1% for detection of myometrial invasion. In same group of females, DWI showed Sensitivity: 84.5%, specificity: 91.0%, PPV: 85.3%, NPV: 90.5%, accuracy: 88.5% for detection of myometrial invasion.

Conclusion: We observed that DCE-MRI and DWI-MRI are reliable in detecting myometrial invasion and DCE has better performance than DWI.

KEYWORDS: Endometrial carcinoma, uterine cancer, myometrial invasion, dynamic contrast- enhanced imaging, magnetic resonance imaging, and diffusion--weighted imaging.

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INTRODUCTION

Endometrial carcinoma, also referred to as uterine cancer, is the fourth most common cancer among women worldwide and the most common gynecological cancer in the United States.1 Because endometrial cancer affects 15% of women who experience postmenopausal bleeding, it's critical that women seek medical attention as soon as possible for evaluation following even one menopausal bleeding episode.2, 3 Transvaginal ultrasonography has been shown to show a superior performance trend when it comes to detecting the spread of cervical tumors. Endometrial carcinoma is typically evaluated through surgical staging because the stage of the condition is critical to treatment planning, female survival, and prognosis. From this point on, transvaginal sonography should be the first imaging modality of choice for patients with endometrial cancer.[4]

One important and well-established predictive risk factor for endometrial cancer is the extent of myometrial invasion. The degree of myometrial involvement should be expressed as a percentage of the overall thickness of the myometrium that the cancer has invaded. Three categories should be used to classify the assessment: no invasion, <50% invasion, and ≥50% invasion.5, 6 Consequently, the need for a proper evaluation of this parameter during the staging is explained by the established function of myometrial invasion as a critical prognostic risk and its significance in selecting the best course of treatment for the patient.[7]

Preoperative planning, disease staging, and treatment planning all heavily rely on magnetic resonance imaging (MRI). In order to customize the surgical strategy for these women, the preoperative evaluation of the histopathological grade and depth of myometrial invasion is essential.8 Over the past 20 years, the astonishing developments in MRI technology have been very

helpful in accurately diagnosing gynecological tumors. It is clear that MRI is quite useful for determining whether a pelvic disease is cancerous. Furthermore, it is commonly acknowledged as a superb imaging method for assessing the local stages of endometrial cancer, specifically for figuring out the degree of invasion.[9]

DWI and T2-weighted imaging (T2WI) are employed for the staging of endometrial cancers. Additionally, endometrial cancer can be staged using T2WI with or without contrast-enhanced MRI.10 With successive fast image capture prior to, during, and following delivery, DCE-MRI measures the pharmacokinetic profile of an injected contrast agent. The signal intensity rises as the paramagnetic agent passes through. Endometrial lesions were identified at various stages with DCE-MRI, and the staging accuracy of endometrial carcinomas was higher than with T2WI (86 vs. 82).[11, 12]

A major factor in determining surgical choices, especially the necessity of lymphadenectomy and adjuvant treatment, is the depth of myometrial invasion. Histopathology is still the gold standard for diagnosing myometrial invasion, but preoperative imaging is essential for organizing the best course of action. Advanced imaging techniques that provide a non-invasive evaluation of tumor features and invasion depth include DCE-MRI and DWI-MRI. Although the diagnostic accuracy of these imaging methods varies from study to study, they have demonstrated promise in identifying myometrial invasion. To demonstrate these imaging modalities' dependability in standard clinical practice, a thorough validation against histology is required.

METHODOLOGY

Ethical approval was obtained from the Institutional Review Board (32/GMC dated 26/04/2025). This Cross sectiona1, validation study was led Department of Diagnostic

Radiology, Gujranwala Teaching Hospital, Gujranwala from 15th August 2025 till 15th of October 2025. Estimation of sample size (n= 270) was done on WHO calculator by using 95% confidence level, sensitivity and specificity of DCE-MRI as 57% and 68% and prevalence of myometrial invasion as 21%.13 All the females, who fulfilled following criteria were enrolled by using Non-probability, purposive sampling technique.

Inclusion criteria: All females of age 50 to 70 years with history of post-menopausal bleeding or menorrhagia, diagnosed with endometrial lesions, detected on ultrasonography admitted for biopsy were enrolled.

Exclusion criteria: Females already had intracranial clipping or had pacemaker or artificial heart valves, cochlear implant, or had artificial joints, vascular stents or taking chemotherapy, chronic renal disease, previous pelvic gynecological surgeries, and allergic to contrast media were excluded.

Informed consent was taken from all the females before enrolment. Female's confidentiality was strictly maintained. The basic demographic information were recorded. All females enrolled were subjected to DEC-MRI and DWI-MRI before the surgery and after the procedure histopathology was done by the pathology department. Eligible females underwent preoperative DCE-MRI and DWI-MRI to assess myometrial invasion. Two radiologists, blinded to histopathological results, independently analyzed the MRI scans, classifying cases as having or not having myometrial invasion based on standardized criteria. The MRI images were examined on Siemens Syngo 2010A workstation software. Following surgery, histopathological analysis was performed on hysterectomy specimens to confirm the depth of myometrial invasion, serving as the gold standard. The MRI findings were then compared to histopathology results to classify cases into true positive, true negative, false positive, and false negative. Myometrial invasion was referred to as extent to which endometrial carcinoma infiltrates the muscular layer (myometrium) of the uterus. If involved <50% of myometrial thickness, it was referred to as superficial invasion but if >50% invasion observed, it was referred to as deep invasion, as per FIGO classification (Stage Ia and Ib).
All data collected was entered and analyzed using SPSS, Version 23. The qualitative data like myometrial invasion on DWI-MRI, DCE-MRI and histopathology were presented as frequency distribution. Quantitative data in the study like age were presented as mean ± SD. After verification, cases were labeled as true positive, false positive, false negative and true negative, as per the operational definition. A 2 x 2 contingency table was created for calculation of specificity, sensitivity and diagnostic accuracy of on DCE-MRI and DWI-MRI for endometrial carcinoma diagnosis taking histopathology as gold standard.

RESULTS

In this study, we observed that the mean age of females was 60.25 ± 6.00 years. The mean BMI was 27.86 ± 4.42 kg/m2. The most common presenting symptom was postmenopausal bleeding that was observed in 176 (65.2%) females, followed by pelvic pain 158 (58.5%) and abnormal uterine bleeding 94 (34.8%). Out of 270 females, 244 (90.4%) had history of hypertension, 188 (69.6%) were diabetic and 109 (40.4%) were obese. Table-I

On DCE-MRI, out of 270 females, 103 (38.1%) were positive for myometrial invasion. On DWI, 102 (37.8%) females were positive and on histopathology, 103 (38.1%) females were positive for myometrial invasion. Figure-1

In this study, we observed that the DCE-MRI had Sensitivity: 92.2%, specificity: 95.2%, PPV: 92.2%, NPV: 95.2%, accuracy: 94.1% for detection of myometrial invasion. In same group of females, DWI showed Sensitivity: 84.5%, specificity: 91.0%,

PPV: 85.3%, NPV: 90.5%, accuracy: 88.5% for detection of myometrial invasion. Table-II

We stratified data for effect modifiers and observed that accuracy is almost similar for all strata. In females aged 50-60 years, DCE-MRI had accuracy of 93.8% and in females aged 61-70 years, the accuracy was 94.3%. Similarly, the accuracy was 93.6% in females with AUB and 94.3% in females without AUB. Similar pattern was observed in females with and without pelvic pain and postmenopausal bleeding. While accuracy of DCE-MRI was high in hypertensive females than non-hypertensive females and among diabetics than non-diabetics. also among obese females, accuracy of DCE-MRI was high in obese females than non-obese females. Table-III

We stratified data for effect modifiers and observed that accuracy is almost similar for all strata. In females aged 50-60 years, DWI-MRI had accuracy of 86.2% while better in over aged females (90.7%). Similarly, the accuracy was 83.0% in females with AUB and 91.5% in females without AUB. Similar pattern was observed in females with pelvic pain (86.1%) has less accuracy than females without pelvic pain (92.0%). The accuracy was 91.5% in females
with postmenopausal bleeding and 83.0% in females without postmenopausal bleeding. While accuracy of DWI-MRI was high in hypertensive females than non-hypertensive females and among diabetics than non-diabetics. also among obese females, accuracy of DWI-MRI was high in obese females than non-obese females. Table-IV

Table-I: Basic demographics and clinical profile of females (n = 270)

	Mean
Age, in years	60.25 ± 6.00
BMI, in kg/m2	27.86 ± 4.42
Presenting symptoms	
Abnormal uterine bleeding	94 (34.8%)
Pelvic pain	158 (58.5%)
Postmenopausal bleeding	176 (65.2%)
Comorbidities	
Hypertension	244 (90.4%)
Diabetes	188 (69.6%)
Obesity	109 (40.4%)

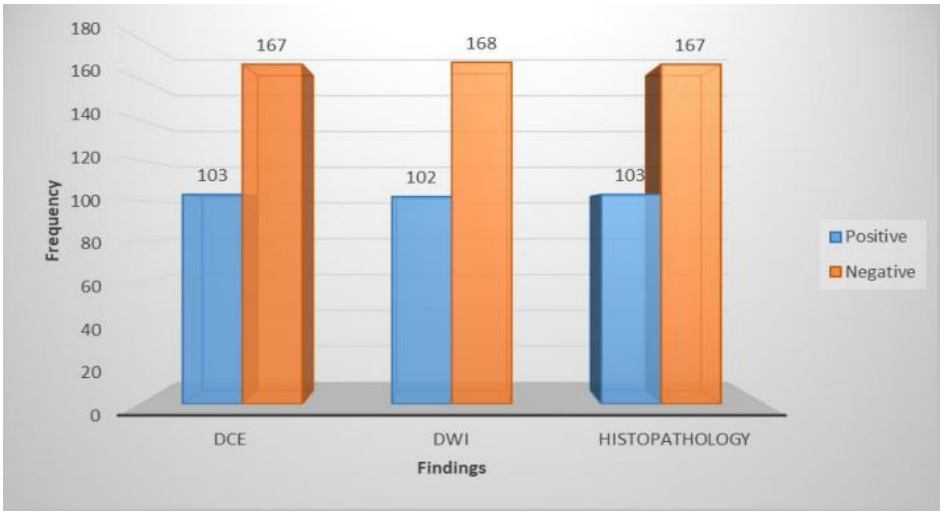

Figure-1: Myometrial invasion on DCE, DWI and histopathology

Table-II: Accuracy of DCE-MRI and DWI for myometrial invasion in contrast to histopathology (n = 270)

		Histopathology findings		Total
		Positive	Negative	
DCE-MRI	Positive	95	8	103
	Negative	8	159	167
Total		103	167	270
DWI	Positive	87	15	102
	Negative	16	152	168
Total		103	167	270
DCE	Sensitivity: 92.2%, specificity: 95.2%, PPV: 92.2%, NPV: 95.2%, accuracy: 94.1%			
DWI	Sensitivity: 84.5%, specificity: 91.0%, PPV: 85.3%, NPV: 90.5%, accuracy: 88.5%			

Table-III: Accuracy of DCE-MRI for myometrial invasion in contrast to histopathology with respect to effect modifiers

	Sensitivity	Specificity	PPV	NPV	DA
Age; 50-60 years	91.5%	95.2%	91.5%	95.2%	93.8%
Age; 61-70 years	92.9%	95.2%	92.9%	95.2%	94.3%
AUB	90.9%	95.1%	90.9%	95.1%	93.6%
No AUB	92.9%	95.3%	92.9%	95.3%	94.3%
Pelvic pain	93.0%	93.1%	88.3%	95.9%	93.0%
No pelvic pain	91.3%	98.5%	97.7%	94.2%	95.5%
PMB	92.9%	95.3%	92.9%	95.3%	94.3%
No PMB	90.9%	95.1%	90.9%	95.1%	93.6%
Hypertensive	93.4%	95.4%	92.4%	96.1%	94.7%
Non-hypertensive	83.3%	92.9%	90.9%	86.7%	88.5%
Diabetic	95.5%	95.1%	91.3%	97.5%	95.2%
Non-diabetic	86.5%	95.6%	94.1%	89.5%	91.5%
Obese	100%	95.5%	83.3%	100%	96.3%
Non-obese	90.4%	94.9%	94.9%	90.2%	92.5%

Table-IV: Accuracy of DWI-MRI for myometrial invasion in contrast to histopathology with respect to effect modifiers

	Sensitivity	Specificity	PPV	NPV	DA
Age; 50-60 years	80.9%	89.2%	80.9%	89.2%	86.2%
Age; 61-70 years	87.5%	92.9%	89.1%	91.8%	90.7%
AUB	75.8%	86.9%	75.8%	86.9%	83.0%
No AUB	88.6%	93.4%	89.9%	92.5%	91.5%
Pelvic pain	80.7%	89.1%	80.7%	89.1%	86.1%
No pelvic pain	89.1%	93.9%	91.1%	92.5%	92.0%
PMB	88.6%	93.4%	89.9%	92.5%	91.5%
No PMB	75.8%	86.9%	75.8%	86.9%	83.0%
Hypertensive	85.7%	91.5%	85.7%	91.5%	89.3%
Non-hypertensive	75.0%	85.7%	81.8%	80.0%	80.8%
Diabetic	87.9%	92.6%	86.6%	83.4%	91.0%
Non-diabetic	78.4%	86.7%	82.9%	83.0%	82.9%
Obese	85.0%	93.3%	73.9%	96.5%	91.7%
Non-obese	84.3%	88.5%	88.6%	84.1%	86.3%

DISCUSSION

In this study, we observed that DCE-MRI had Sensitivity: 92.2%, specificity: 95.2%, PPV: 92.2%, NPV: 95.2%, accuracy: 94.1% for detection of myometrial invasion. In same group of females, DWI showed Sensitivity: 84.5%, specificity: 91.0%, PPV: 85.3%, NPV: 90.5%, accuracy: 88.5% for detection of myometrial invasion. Many studies have been conducted to assess the diagnostic accuracy of DCE-MRI and DWI-MRI in the diagnosis of endometrial cancer, with histology serving as the gold standard. The sensitivity, specificity, and diagnostic accuracy of DWI were 85.7%, 92.8%, and 95%, respectively.14, 15 A study conducted in Pakistan found that DCE-MRI was 85.7% accurate in assessing the degree of myometrial invasion in endometrial cancer cases.16 In another study, DCE-MRI and DWI were compared to identify the depth of myometrial invasion in endometrial cancer. According to the study, DCE-MRI was more accurate at assessing the degree of myometrial invasion (91.4%) than DWI (80%).17 Our study's results are consistent with those of a study conducted by Aly et al., as in that study. DCE was reported to be highly reliable and accurate for detection of myometrial invasion.

DWI outperformed DCE-MRI in terms of diagnostic accuracy when determining the extent of myometrial invasion, according to a study published in Radio Graphics.13 The findings of Zandrino et al., also demonstrated the value of DCE-MRI in endometrial tumor cases, where DWIs detected the depth of myometrial invasion with accuracy and sensitivity of 87%, specificity of 90%, PPV of 85%, and NVP of 92%.18 In a different study, Beddy et al., found that myometrial invasion was shown to be 21% common, while DCE-MRI sensitivity and specificity were 58% and 68%, respectively.19 Muzaffar et al. report that the PPV of DWI for identifying deep myometrial invasion was 94.4%.[20]

In another investigation, Gil et al. found that combined DWI imaging had a 95% PPV for detecting deep myometrial invasion, which is almost identical.21 Anjum et al., conducted a study previously in local population and revealed a PPV of 98.4%, which is far higher than what is currently observed..22 Additionally, it was discovered that the combined DWI had a 100% PPV for identifying myometrial invasion.23 DWI's sensitivity, specificity, PPV, NPV, and accuracy were 45.45%, 90.48%, 71.43%, 76.0%, and 75.0%, according to Nurdillah et al.
For DCE-MRI, the equivalent numbers were 81.82%, 76.19%, 64.29%, 88.89%, and 78.12%, in that order. As a result, DCE-MRI had higher sensitivity and accuracy than DWI when it came to determining the extent of myometrial invasion.24 The accuracy of determining the myometrial depth invasion has been increased with the usual use of DCE-MRI (accuracy rate: 85%-91% for DCE vs. 55%-77% for DWI).[25-27]

CONCLUSION

We observed that DCE-MRI and DWI are reliable in detecting myometrial invasion and DCE has better performance than DWI. These imaging techniques have shown potential in detecting myometrial invasion. Now in future, we can rely on DCE and DWI for confirmation of myometrial invasion and can reduce surgical interventions.

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