Original Article

Role of Diffusion Weighted MRI in Assessment of Deep Myometrial Invasion by Endometrial Tumor-Comparing with Histopathology

Diagnosing of Endometrial Tumor by MRI

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ABSTRACT

Objective: To evaluate the diagnostic accuracy of Diffusion Weighted Magnetic Resonance Imaging in Assessment of deep myometrial invasion by endometrial tumor, taking histopathology as a gold standard.

Study Design: cross sectional study.

Place and Duration of Study: This study was conducted at the Department of Diagnostic Imaging in Nishtar Hospital, Multan, Pakistan from October 2016 to October 2018.

Materials and Methods: Total 75 patients having endometrial carcinoma, ages between 20-60 years were included. Patients with previous uterine surgery, receiving radiotherapy and chemotherapy, claustrophobia and cardiac pacemakers were excluded. Diffusion weighted MRI of the abdomen and pelvis was done in all. DW-MRI finding were interpreted by consultant radiologist for presence or absence of deep myometrial invasion. After surgery specimenswere sent to the institutional pathology laboratory for histopathology.MRI findings were compared with histopathology. Data was analyzed using SPSS-18. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy were calculated.

Results: Total 75 patients fulfilling inclusion criteria were included. 38 (True Positive) had deep myometrial invasion on histopathology. Among 35DW-MRI negative patients ,01 (false negative) had deep myometrial invasion on histopathology (p=0-0001). Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of diffusion weighted imaging in assessment of deep myometrial invasion by endometrial tumor, taking histopathology as gold standard was 97.43%,94.44%,95.00%,97.14% and 96.00% respectively.

Conclusion: Study concluded that DW-MRI is a highly sensitive and accurate noninvasive modality for diagnosing deep myometrial invasion by endometrial tumor.

Key Words: Endometrial cancer, myometrial invasion, diffusion weighted imaging.

INTRODUCTION

Endometrial cancer is currently the most common gynecological malignancy of the female pelvis in the united states and European countries and its incidence is increasing in other parts of the world.[1] The histological tumor grade and depth of myometrial invasion correlates strongly with the prevalence of lymph node metastasis and with patient survival. The myometrial invasion ratio determines the FIGO stage and thus has a direct impact on management.[2]

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To date, magnetic resonance imaging (MRI) is an accurate imaging technique for preoperative assessment of endometrial cancer and for evaluating the depth of myometrial invasion. A recent meta-analysis demonstrated that contrast enhanced MRI was substantially better than ultrasonography, CT scan, or non-contrast MRI.

Moreover, dynamic contrast enhanced MRI (DCE-MRI) is considered more accurate than T2W imaging in tumor detection and in assessment of myometrial invasion due to greater contrast and clear demonstration of border between the tumor and myometrium in the earlyphase. However, recent concerns with respect to the development of nephrogenic systemic fibrosis in patients with renal insufficiency, who undergo contrast enhanced MRI, are increasing the need of non-enhanced imaging. A few studies reported that DWI might be useful for detecting the depth of myometrial invasion with high diagnostic accuracy as well as predicts tumor grade. DWI with apparent diffusion coefficient(ADC) measurement yields quantitative information, which reflects cellularity of the tissue, and may be helpful to differentiate relatively hypercellular

endometrial cancer from normal endometrial and benign endometrial lesions.[3]

The rationale of this study was to determine the diagnostic accuracy of diffusion weighted MRI in assessment of myometrial invasion by endometrial tumor in local population. This study will not only be a useful addition in the existing literature but our general population will also be provided a non-invasive imaging modality for pre-operative assessment of endometrial carcinoma.

MATERIALS AND METHODS

This cross-sectional study was carried out in department of radiology Nishtar Medical College & Hospital, Multan-Pakistan in two years from Oct, 2016 to Oct,2018 on 75patients. Socio-demographics such as age, gender and duration of symptomswere collected. Those patients who have age range between 20 to 60 years and havingendometrial carcinoma of more than three months' duration were included in the study to determine the diagnostic accuracy of DWIin detection of depth of invasion of myometrium.

Informed consent was taken before performing MRI. All the sequences were done during a single breath hold at two b-values (0mm2/sec and 1000 mm2/sec) and scan time of 3-4 minutes. DW MR findings were interpreted by consultant radiologist for presence or absence of deep myometrial invasion. All patients underwent surgery in the concerned ward and histopathology was send to the institutional pathology laboratory. DW-MRI findings were compared with histopathology findings.

Data was entered and analyzed using computer program SPSS-18. Descriptive statistics were applied to calculate mean and standard deviationfor quantitative variables. Frequencies and percentages were calculated for the qualitative variables. Sensitivity, specificity, PPV, NPV and

diagnostic accuracy of DW-MRI were calculated. Effect modifier were controlled by stratification. Chi-square test was applied post stratification and p-value ≤0.05 was considered as significant

RESULTS

Total 75 patients fulfilling inclusion criteria were included. Mean age of patients was 37.25±6.57 years with range of (35-60) years. The overall mean duration of disease was 43.82±12.55 months, with range of 45(19-64) months. All patients were subjected to Diffusion Weighted Magnetic Resonance Imaging.DW-MRI supported the diagnosis of deep myometrial invasion by endometrial tumor in 40(53.33%) patients and no deep myometrial invasion in 35 (46.66%) patients. Histopathology findings confirmed deep myometrial invasion by endometrial tumor in 39(52,00) patients and no deep myometrial invasion in 36(48.00%) patients. In DW-MRI positive patients ,38

True Positive (50.66%) had deep myometrial invasion and 02 False positive (2.66%) had no deep myometrial invasion on histopathology. Among 35, DW-MRI negative patients, 01 (False Negative) had deep myometrial invasion on histopathology, whereas 34 (True Negative) had no deep myometrial invasion on histopathology (p=0.0001) as shown in table I

Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy of DW-MRI in diagnosis of deep myometrial invasion taking histopathology as gold standard were 97.43%, 94.44%, %, 95.00%,97.14% and 96.00 % respectively. The stratification according to gender, age, and duration of disease was done and sensitivity, specificity and diagnostic accuracy were also calculated post stratification.
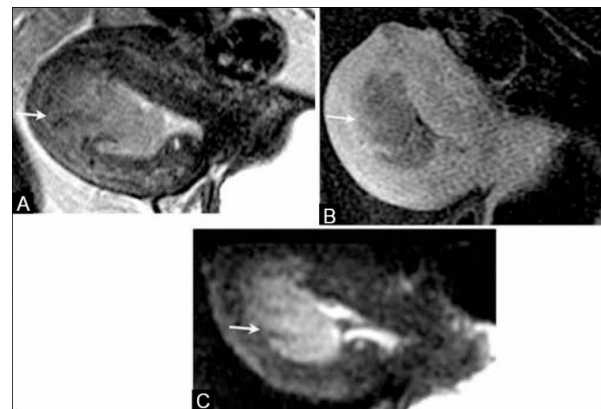

Figure No.1: I68 yr. female with endometrial cancer. DW-imaging showing >50%myometrial invasion by tumor.

Table No. 1: Diagnostic Accuracy of Dw-Mri in Assessment of Deep Myometrial Invasion by Endometrial Tumor (n=75)

Dw-Mri Findings	Histopathology Findings		Total
	Positive	**Negative**	
Positive	True positive(a) 38 (50.66%)	False positive (b) 02(2.66%)	a + b 40(53.33%)
Negative	False negative(c) 01 (1.33%)	True negative (d) 34(45.33%)	c + d 35(46.66%)
Total	**a + c 39(52.00 %)**	**b + d 36(48.00%)**	**75 (100%)**

Sensitivity= a / (a + c) x 100 = 97.43%
Specificity= d / (d + b) x 100 = 94.44%
PPV = a / (a + b) x 100 = 95.00%
NPV = d / (d + c) x 100 = 97.14%
Accuracy = a + d / (a + d + b + c) x 100 = 96.00%

Post stratification association of outcome with age and duration of disease were calculated using chi square test considered p≤0.05 as significant. The results showed

significant association with age, marital status, menopause status and duration of disease.

Significant association was observed with marital status, menopause status and duration of disease.

DISCUSSION

Magnetic resonance imaging (MRI) is more accurate approach for the assessment of endometrial carcinoma staging compared with ultrasonography and CT before surgery. The combination of T2W and DWI fuses morphological and functional observations, which can improve the anatomical localization of lesions, and the entire procedure takes <30 seconds.[4] Reports have shown that the fused images are very good modality for displaying anatomical structure and functional information, and improve the accuracy of diagnosis.[5]

This study is conducted to determine the accuracy of diffusion DW-MRI in assessment of deep myometrial invasion by endometrial tumor, taking histopathology as gold standard. DW-MRI supported the diagnosis of deep myometrial invasion by endometrial tumor in 40 (53.33%) patients and no deep myometrial invasion in 35(46.66%) patients. Histopathology findings confirmed deep myometrial invasion by endometrial tumor in 39(52.00 %) patients and no deep myometrial invasion in 36(48.00 %) patients. In DW-MRI positive patients, 38 (True Positive) had deep myometrial invasion and 02(False positive) had no deep myometrial invasion on histopathology. Among 35, DW-MRI negative patients, 01 (False Negative) had deep myometrial invasion on histopathology, whereas 34 (True Negative) had no deep myometrial invasion on histopathology (p=0.0001).

Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy of DW-MRI in diagnosis of deep myometrial invasion taking histopathology as gold standard were 97.43%, 94.44%, 95.00%, 97.14% and 96.00% respectively.

Noninvasive DWI depicts differential molecular diffusion movements of water with in various tissues. With DWI, increased cellularity and few mesenchymal structures between the glands in endometrial carcinomas may restrict water diffusion when compared with a normal endometrium.[6] Several research groups have analyzed the usefulness of DWI in the detection and assessment of myometrial invasion in endometrial cancer. Researchers have reported that staging errors were excluded when incorporating DWI, and conventional MRI based on the fusion of DWI lesions for endometrial cancer is more sensitive for the effective assessment of lesions.[7]

In a recent prospective study published in European Radiology in 2010, Rechichi et al. found that DW-MRI was very accurate in assessing myometrial invasion with sensitivity, specificity, positive and negative predictive value of 84.6%,70.6%,52.4%, and 92.3%.[8]The crossponding values for dynamic MRI and T2W imaging were 69.2%,61.8%,40.9%,84.0% and 92.3%,76.5%,60.0%96.3% respectively. The inter-observer agreement in assessing the depth of myometrial invasion was substantial for both T2W and DW imaging (k=0.91 and 0.74 respectively) and moderate for dynamic imaging (k=0.45). They suggested that DWI could potentially replace dynamic imaging as an adjunct to routine T2W for preoperative evaluation of endometrial cancer.[9]

Shen at al. compared the use of DW-MRI and DCE-MRI in the evaluation of depth of myometrial invasion and found that the diagnostic accuracy was 62% for DW-MRI compared to 71% for DCE-MRI. However, both DW-MRI and DCE-MRI images were acquired in the sagittal plane only. This may have contributed to a relatively low accuracy in the evaluation of myometrial invasion as the presence of two orthogonal planes is mandatory for an accurate assessment.[10] DW-MRI was also useful in detection of drop metastasis in the cervix or metastasis foci outside the uterus, such as adnexa or peritoneum. In et al demonstrated an accuracy of 88% in determining the depth of myometrial invasion using fused T2W and DW images at 3.0 T.[11]

In a study, magnetic resonance imaging had a high negative predictive value for the presence of deep invasion (87% overall and 95% for grade I disease). However, although the positive predictive value for the presence of any myometrial invasion was high ,negative predictive values were poor (35%for all grades and 46% for grade I).In another study ,for the detection of outer –half myometrial invasion ,overall sensitivity of MRI was 0.73 (95% CI,0.59-0.83) and specificity was 0.83(95% CI,0.76-0.89).12 Magnetic Resonance Imaging improved the sensitivity and negative predictive value of endometrial biopsy alone in predicting the women with endometrial cancer who require full surgical staging (0.73 vs 0.65 and 0.80 vs 0.78,respectively)[12]

Ryoo UN et al in his study found the sensitivity, specificity and accuracy for identifying any myometrial invasion (superficial or deep as 0.81 ,0.61 and 0.74 respectively; these values for deep myometrial were 0.60,0.94 and 0.86 respectively. The sensitivity, specificity and accuracy of MR imaging for detecting lymph nodes metastasis were 50.0%,96.6% and 93.0% respectively.[13] The patients who were older ,had more deliveries and a larger tumor size more frequently had incorrect prediction of deep myometrial invasion (p=0.034,p=0.044,p=0.06,respectively).[14]A higher tumor grade ,a histology other than the endometrioid type, myometrial invasion on MR findings and a larger tumor size were associated with a more frequent false negative prediction of lymph node metastasis (p=0.018,p=0.017,p=0.002,p=0.047,respectively).A

large tumor size was also associated with more frequent false-positive results (p=0.009).[15]

CONCLUSION

This study concluded that DW-MRI is a highly sensitive and accurate non –invasive modality for diagnosing deep myometrial invasion by endometrial tumor, and has improved patient care by early screening timely and proper treatment and avoiding unnecessary diagnostic biopsies, which consequently reduces patient's morbidity and mortality. So we recommend that diffusion weighted MRI should be used routinely as a prime modality for pre-operative status of assessment of deep myometrial invasion by endometrial tumor for selecting proper treatment option and post-operative management plan for these particular patients which will result in reducing the morbidity and mortality of these patients.

Author's Contribution:

Concept & Design of Study:	Sadia Anjum
Drafting:	Abdul Sattar
Data Analysis:	Saeeda Rana
Revisiting Critically:	Sadia Anjum, Abdul Sattar
Final Approval of version:	Sadia Anjum

Conflict of Interest: The study has no conflict of interest to declare by any author.

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