

Original Article

Clinical Utility and Diagnostic Accuracy of Diffusion Weighted Imaging in Early Detection of Endometrial Carcinoma with Histopathological Concordance/Discordance: Experience of a Tertiary Care Hospital

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Abstract

Objective: To evaluate the diagnostic accuracy of diffusion-weighted imaging (DWI) in the early detection of endometrial carcinoma, using histopathological findings as the gold standard.

Methodology: This prospective cross-sectional study was conducted at the Radiology Department of Dr. Ziauddin Hospital, Karachi, from December 27, 2019, to June 26, 2020. A total of 280 women aged 40–80 years presenting with abnormal uterine bleeding and thickened endometrium on ultrasound were included. All patients underwent pelvic MRI with diffusion-weighted sequences, followed by diagnostic dilatation and curettage (D&C) for histopathological correlation. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy were calculated using SPSS version 22.

Results: The average age of the patients was 59.17±9.0 years. Diagnostic accuracy of DWI-MRI was found to be 76.43% in diagnosis of endometrial carcinomas with sensitivity of 74.31%, specificity 78.68% PPV 78.68% and NPV 74.31% respectively.

Conclusion: DWI is a non-invasive, contrast-free, and cost-effective imaging modality that enhances diagnostic confidence in detecting endometrial carcinoma. When used in conjunction with conventional MRI sequences, it offers valuable information for preoperative staging and treatment planning, with diagnostic parameters closely aligned with histopathological outcomes.

Key Words: Endometrial carcinoma, malignancy, Diffusion weighted imaging, myometrial invasion.

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Introduction

Carcinoma of the endometrium is the foremost gynecological malignancy in developed countries and the sixth most common in women worldwide.¹ The overall incidence of endometrial carcinoma has been increased worldwide especially in countries with swift socioeconomic transitions. According to recent cancer statistics, there is 1.3% per year increase in the incidence of endometrial carcinoma from 2007- 2016.² It usually occurs in women more than 50 years of age in >90% of the cases and in only 4% of the cases it occurs in women < 40 years of age.⁽³⁾ It has an advantage of early diagnosis as most of the postmenopausal women

presents with an atypical vaginal bleeding. The overall 5-year survival rate is between 20% to 95% and mainly depends on three important prognostic factors: grade and histological subtype, local stage of tumor at diagnosis; and the status of lymph nodes metastasis.⁴

The depth of myometrial invasion has the greatest prognostic value in relation with tumor grade, lymph node metastases, and overall patient survival. More than 50% myometrial invasion increases the risk of pelvic and para aortic lymph node metastasis to six to seven times with need of more aggressive surgical management.⁵ The tumor staging is usually performed intraoperatively

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according to International Federation of Gynecology and Obstetrics (FIGO) guidelines; however, MRI Pelvis is usually done for preoperative staging of the tumor and to plan appropriate therapeutic approach. MRI is the most effective technique in the assessment of myometrial invasion, cervical stromal invasion, and lymph node metastases.⁶

DWI is an efficient imaging technique that gives important information regarding mobility of water molecules, tissue cellularity, and the integrity of cellular membranes. On DWI, endometrial cancer demonstrates restricted diffusion in comparison with normal myometrial tissue, resulting in high b-values and low apparent diffusion coefficient (ADC) values. ADC values are also significantly lower in endometrial cancer than in normal endometrium or in benign conditions.⁷ It is also useful in assessing treatment response and to detect disease recurrence. It is a functional imaging technique as its contrast is derived from the random movement of water molecules of the tissues, therefore, no need of any exogenous contrast administration. So, it can be helpful in patients in whom contrast is contraindicated. It can be used with normal T2W images and can replace the use of contrast enhanced MRI.⁸

This study aimed to evaluate the clinical utility and diagnostic accuracy of Diffusion weighted imaging in early detection of endometrial carcinoma with histopathological concordance / discordance

Methodology

A cross-sectional prospective study was conducted in Radiology department of Dr. Ziauddin Hospital from 27th December, 2019 to 26th June 2020 after approval from the research evaluation unit of College of Physicians and Surgeons of Pakistan. Ref no: CPSP/REU/RAD-2016-201-2240. Non-probability consecutive sampling was done. All the patients ranging in age from 40-80 years who presented with abnormal intermenstrual or postmenopausal bleeding and showed thickened endometrium on ultrasound were included in the study. Patients with pervaginal bleeding due to known clotting disorder or blood dyscrasias, with normal endometrium on ultrasound, pathologically proven endometrial carcinoma and who had suboptimal MRI examination due to motion artifact, claustrophobia or non-cooperation were excluded from the study. Confounding variables and biasness were controlled by strictly following inclusion criteria. Sample size was calculated by taking sensitivity of 95.5% and specificity of 92.9% DWI-MRI in detection of Endometrial carcinoma, prevalence of 25%

^{9, 10}, and confidence interval of 95% and desired precision of 8.5% for sensitivity and specificity, the calculated sample size was 280. Informed consent was taken after explaining the procedure, risks and benefits of the study. Magnetic Resonance Imaging of Pelvis with diffusion weighted sequence (DWI) was performed on 1.5T Siemens MRI scanner. Images were evaluated by a Senior Consultant Radiologist. Diagnostic dilatation and curettage (D & C) was then performed by a Gynecologist and specimen was sent for histopathology. Results of the histopathology reports were followed and recorded on Proforma. Data was entered and analyzed by using statistical package for social science (SPSS) version 22. Mean and standard deviation were calculated for age and parity. A 2x2 table was used to calculate the sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of DW-MRI taking histopathology as gold standard. Effect modifiers were controlled through stratification of age and parity to see the effect of these on outcome variables. Post stratification, 2x2 table was used to calculate sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy.

Results

In this study, 280 patients were included to assess the diagnostic accuracy of DWI in the detection of endometrial carcinoma taking histopathology as gold standard. The results showed that the mean age of the patients were 59.17 ± 9.0 and the mean parity was found to be 4.039 ± 1.81 . The mean duration of disease was 11.17 ± 6.31 months.

Table I: Diagnostic accuracy of DWI-MRI by using histopathology as gold standard. (n=280)

DW-MRI	HISTOPATHOLOGY	
	POSITIVE	NEGATIVE
POSITIVE	107	29
NEGATIVE	37	107
Total	144	136

Endometrial carcinomas was noted in 136 (48.6%) patients on DWI-MRI findings, while 144 (51.4%) patients showed endometrial carcinoma on histopathology. (Table I) Diagnostic accuracy of DWI-MRI was found to be 76.43% in diagnosis of endometrial carcinomas with sensitivity of 74.31%, specificity 78.68% PPV 78.68% and NPV 74.31% respectively. (Figure.1) Further stratification of age group, parity and duration of disease were done with respect to diagnostic accuracy of DWI-MRI as shown in (Table II)

Table II: Stratification of different variables.

Stratification	N	Sensitivity %	Specificity %	PPV %	NPV %	DA %
Age						
40-60 years	159	71.59	80.28	81.82	69.51	75.47
>60 years	121	78.57	76.92	74.58	80.65	77.69
Parity						
0-3	109	73.08	75.44	73.08	75.44	74.31
>3	171	75	81.01	82.14	73.56	77.78
Duration of disease						
0-10 months	139	73.42	81.67	84.06	70	76.98
>10 months	141	75.38	76.32	73.13	78.38	75.89

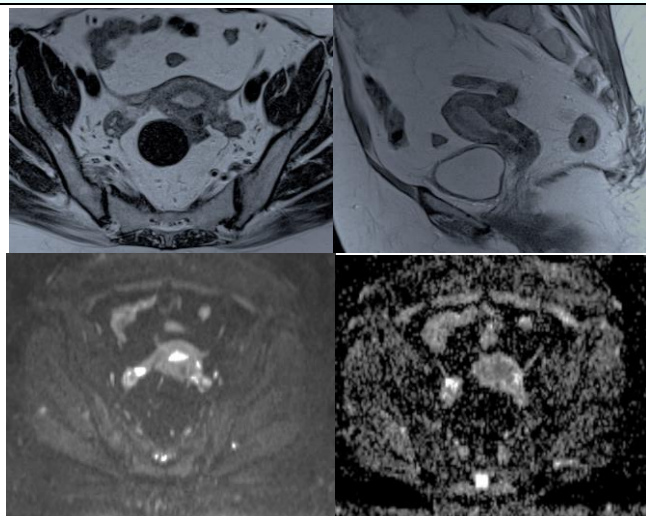


Figure 1. MRI Pelvis of a 60 year old female showing central distended endometrial cavity measuring 1.0 cm. An ill-defined heterogeneous hypointense signal intensity area is seen within the fundal endometrium on T2WI showing diffusion restriction. Findings are compatible with neoplastic mass lesion. Histopathology confirmed FIGO Grade I endometrioid carcinoma.

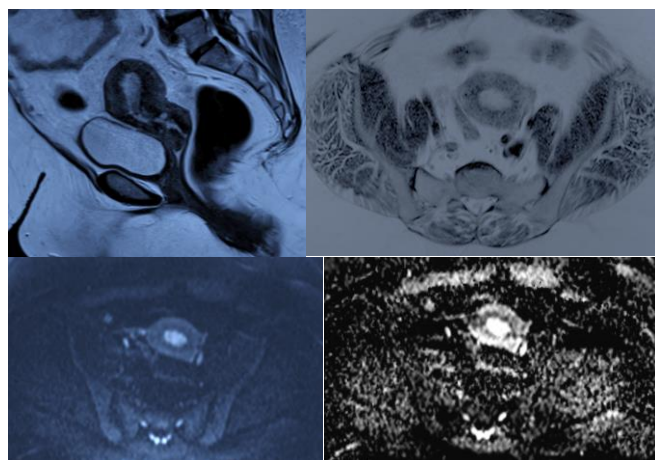


Figure 2. MRI Pelvis of a 65 year old female showing central distended endometrial cavity measuring 1.1 cm. An ill-defined heterogeneous hypointense signal intensity area is seen within the fundal endometrium on T2WI not showing diffusion restriction on DWI and ADC mapping. Findings are suspicious for neoplastic mass lesion. Histopathology confirmed FIGO Grade I endometrial adenocarcinoma.

Discussion

Endometrial carcinoma is the most prevalent malignancy of female reproductive system. The tumor shows

variable behavior and prognosis depending upon the depth of myometrial invasion, histological grading and hematogenous and lymphatic involvement. MRI Pelvis is considered the imaging modality of choice to detect the

characteristics of tumor and to evaluate these prognostic parameters that will help in further management and treatment planning.¹¹

For the depth of myometrial invasion, T2WI has been widely used; however, the combined assessment with DWI and ADC will further increase the diagnostic accuracy. Diffusion weighted imaging will reflect the microstructural features of the tissue by detecting brownian motion, tissue cellularity and nuclear to cytoplasmic ratio. DWI enables quantitative assessment of malignancy by using ADC values. ADC values act as imaging biomarkers and they tend to show lower values of malignant lesions as compared to normal tissue or benign lesions. DWI has an added advantage of shorter acquisition time and does not require intravenous contrast administration. However, DWI is a motion sensitive sequence and is prone to heterogeneity of local field and does not give anatomical details. Therefore, it should be used along with T1 and T2 weighted sequences for proper spatial resolution and anatomical

details. This will reduce the false positive results and will avoid confusion with other normal structures and benign lesions such as bowel loops, lymph nodes, hemorrhagic cyst or endometriosis that also shows high signal intensity on DWI.¹²

In this study, the range of patient's age was variable. A total of 280 patients were studied aged between 42 and 79 years with mean age of 59.17 years. This was in keeping with the western literature which also provided similar range of ages for the occurrence of endometrial cancer.^{13,14} The mean parity was found to be 4.039 ± 1.81 with mean duration of disease of 11.17 ± 6.31 months. The diagnostic parameters calculated in this study for detection of endometrial carcinoma using diffusion weighted imaging include a sensitivity of 74.31%, specificity of 78.68%, PPV of 78.68% and NPV of

74.31%. Diffusion restriction was present in most of the patients with endometrial carcinoma as shown in Figure 1. However, in some of the cases false negative results were seen in which the DWI and ADC mapping were not showing any restriction, however, on histopathology it turned out to be endometrial carcinoma as shown in Figure 2.

Another study conducted by Inada et al.¹⁵ in the detection of uterine endometrial cancer in comparison to conventional non-enhanced MR images. They concluded the sensitivity of 83% by using only T2WI, however, the sensitivity increased 96% when combined diffusion and T2 weighted images were used. These findings have been further validated by Ozturk et al.⁽¹⁶⁾ and Gallego et al.¹⁷ who also used supplementary ADC values for robust results.

Lymph nodes are easier to detect on DWI than on T2WI because of their high b-values, however, it should be combined with the classical morphological criteria that includes the size, contour and presence of central necrosis. The recommended size criteria is >8mm for pelvic and >10mm for abdominal lymph nodes in short axis dimension. No definite established follow up criteria have been made for patients with endometrial carcinoma; however, 3-5 year follow up is usually used. Most of the recurrences occur during this period of treatment with Stage I-II endometrial carcinomas, therefore, frequent follow ups are recommended until at least 3 years.⁽¹⁸⁾

Conclusion

Diffusion weighted imaging is a cheap, readily available and non-invasive technique that can aid in the diagnosis of endometrial carcinoma with increased sensitivity and specificity. It can give both qualitative and quantitative assessment of the tumor and the results are relatively comparable with the histopathological findings. It may be used as a biomarker for tumor response, tumor aggressiveness and can serve as an important indicator for optimization of treatment and further management.

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