

Diagnostic Accuracy of MRI in Detecting Parametrial Invasion in Carcinoma Cervix

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Abstract

Objective: To evaluate the accuracy of MRI in detecting parametrial invasion in carcinoma of cervix keeping histopathological findings as gold standard.

Study design, settings and duration: A cross sectional study was conducted in Radiology Department, Holy Family Hospital, Rawalpindi from November 2017 to October 2018.

Patients and Methods: One twenty eight patients with biopsy proven cervical cancer were enrolled. Magnetic resonance imaging of study patients was performed on 1.5 Tesla GE MRI machine using pelvic array coil for pelvic scan. Positive patients were then sent to gynecology department for hysterectomy after which the specimens were sent for histopathological analysis. All the specimens were reviewed by experienced histopathologist and were labelled as positive and negative for cervical parametrial invasion.

Results: Mean age of study patients (n=128) was 49.9 years \pm 6.7 standard deviation, with a range of 41-69 years. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy of MRI in detecting parametrial invasion in carcinoma of cervix was found to be 84.5%, 84.2%, 86.9%, 81.3% and 84.3% respectively.

Conclusion: MRI is a reliable and non-invasive diagnostic imaging modality that allows the detection of parametrial invasion in patients of cervical cancer with high sensitivity, specificity and accuracy.

Key words: Carcinoma cervix, diagnostic accuracy.

Introduction

Cervical carcinoma is one of the most common malignancies affecting women.¹ It ranks fourth among women both in terms of incidence and mortality with an estimated 570,000 cases and 311,000 deaths in 2018 worldwide.² Invasive cervical cancer is also one of the commonest malignancies in developing countries including Pakistan.³ Cervical cancer is the fourth most common cancer in Pakistan with an age standardized risk (ASR) per 100,000 women of 7.5, although these data come from a limited sampling of

the population of Pakistan (~1%) and the incidence of cervical cancer is likely to be on the rise.^{4,5}

Treatment options for cervical carcinoma include hysterectomy, chemotherapy and radiotherapy. Accurate staging of cervical carcinoma is essential for patient selection and planning management.⁶ The most important factor in staging cervical cancer and treatment planning is presence or absence of parametrial invasion which can significantly affect surgical outcome.^{7,8} It is believed that parametrial invasion is present in 40-73% of patients with cervical cancer.⁹

International Federation of Gynecology and Obstetrics (FIGO) classification is currently being used to stage cervical carcinoma.⁷ Hysterectomy is the treatment option for patients without parametrial involvement which are staged as IIa and lower. Patients with parametrial invasion are staged as IIb and higher and are treated with combination of radiotherapy and chemotherapy.¹⁰

Various imaging modalities are currently employed for determining the extent of carcinoma cervix including ultrasound, barium enema, intravenous urography, computed tomography (CT), PET and MRI. MRI is a useful and accurate tool in the diagnosis, staging, and follow-up of cervical

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RR, MK, SW, SN, SA & KR conceptualized the project, did the Literature search and drafting, revision and writing of manuscript. Data collection was done by RR, MK, SW & SA. RR, MK, SN & KR performed the statistical analysis.

carcinoma.¹¹ The advantages of MRI include; lack of ionizing radiation, non-invasive imaging modality and good soft tissue resolution. It can accurately determine the site and size of tumor, presence or absence of parametrial invasion and extension into uterus or vagina.¹²⁻¹⁵ Sensitivity and specificity of MRI in detecting parametrial invasion is 81.7% and 96% respectively.^{16,17} Rationale of study is that preoperative staging of cervical carcinoma by MRI can help the gynecologists in making decision regarding hysterectomy. Hysterectomy can be performed if parametrium is free of tumor as detected by MRI and vice versa. Although much work has been done in detecting parametrial invasion by MRI in developed countries but its accuracy has not been evaluated much in our part of the world. This study was conducted to bridge this knowledge gap and to highlight the importance of MRI in detecting parametrial invasion in cervical cancer thus planning patient management.

Patients and Methods

A cross sectional study was conducted in Radiology Department, Holy Family Hospital, Rawalpindi from November 2017 to October 2018. Patients with histopathologically proven cervical cancer diagnosed within 6 months with cancer confined to cervix on clinical examination and scheduled for hysterectomy within one month of pelvic MRI having no contraindication to hysterectomy were included in the study.

Patients having other pelvic malignancies locally invading cervical parametrium, with evidence of distant metastasis, inflammatory diseases of cervix and pregnant patients were excluded.

The study included 128 patients with biopsy proven cervical cancer. Sample size (n=128) was calculated by taking sensitivity 81.7%, specificity 96%, absolute precision 10%, expected prevalence 45.6% and confidence level.

The ethical approval for this study was taken from internal review board of the institution. A detailed history, local examination and informed consent were obtained from all patients included in study after which they were subjected to MRI pelvis. MRI scan was performed on 1.5 Tesla GE MRI machine using pelvic array coil for pelvic scan. MRI scan consisted of axial and sagittal T1 weighted spin echo sequence, T1 weighted contrast enhanced image and axial and sagittal T2 weighted spin echo sequences. The pelvic MRI scans were interpreted by experienced radiologist with more than 5 years of post-fellowship experience and were labelled as positive and negative for cervical parametrial invasion. Patients were then sent to

gynecology department for hysterectomy after which the specimens were sent for histopathological analysis. All the specimens were reviewed by experienced histopathologist with more than 5 years of post-fellowship experience and were labelled as positive and negative for cervical parametrial invasion. A 2x2 table was used to calculate sensitivity, specificity, positive predictive value, negative predictive value and accuracy of MRI for detecting cervical parametrial invasion using the findings of histopathology as gold standard.

The formulas that were used for calculation are as follows:

1. Sensitivity = $\frac{\text{True Positive}}{\text{True Positives} + \text{False Negatives}} \times 100$
2. Specificity = $\frac{\text{True Negative}}{\text{True Negatives} + \text{False Positives}} \times 100$
3. Positive Predictive Value = $\frac{\text{True Positive}}{\text{True Positives} + \text{False Positives}} \times 100$
4. Negative Predictive Value = $\frac{\text{True Negative}}{\text{False Negatives} + \text{True Negatives}} \times 100$
5. Accuracy = $\frac{\text{True Positives} + \text{True Negatives}}{\text{True Positives} + \text{True Negatives} + \text{False Positives} + \text{False Negatives}} \times 100$

Results

Mean age of study patients (n=128) was 49.9 years ± 6.7, with a range of 41 - 69 years. On MRI examination, parametrial invasion was seen in 69 (53.9%) patients. Eighty eight percent patients were married. Eighty one percent study patients were nulliparous. Positive family history of gynecological of breast malignancy was present in 40% of study patients.

Table 1: Two x two table.

MRI	Histopathology		Total
	Parametrial Invasion Present	Parametrial Invasion Absent	
Parametrial invasion present	60 (True positive)	9 (False positive)	69
Parametrial invasion absent	11 (False negative)	48 (True negative)	59
Total	71	57	128

Histopathology results showed that 71 (55.4%) patients had evidence of parametrial invasion. Results showed that overall 46.8% were true positives, 37.5% were true negatives, 7% were false positives and 8.5% were false negatives

(Table-1). Results depicted that sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy of MRI in detecting parametrial invasion in carcinoma of cervix is 84.5%, 84.2%, 86.9%, 81.3% and 84.3% respectively (Table-2).

Table 2: Sensitivity, specificity, PPV, NPV and accuracy of MRI in detecting parametrial invasion in patients of cervical carcinoma.

Sensitivity (TP/ TP + FN)	84.5%
Specificity (TN/ TN + FP)	84.2%
Positive predictive value (TP/TP + FP)	86.9%
Negative predictive value (TN/ FN + TN)	81.3%
Accuracy	84.3%

Table 3: MRI findings suggestive of parametrial invasion.

MRI Findings	%
Inhomogeneous signal intensity of cervical stroma	32.8
Focal and complete disruption of hypointense cervical stromal ring	27.3
Peritumoural fat stranding	23.4
Tumour bulging/ presence of soft tissue mass in parametrial tissue	16.4

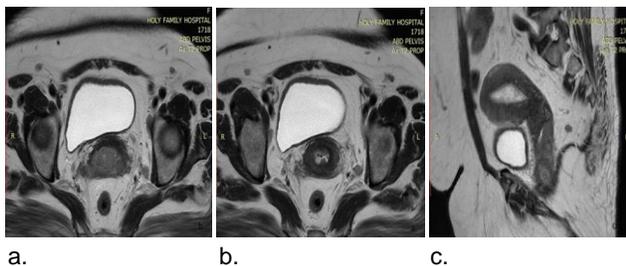


Figure 1: T2WI axial (a, b) and sagittal (c) images demonstrating carcinoma centered on the posterior wall of the cervix. Tumour is infiltrating into the surrounding high signal fat. A left perilesional lymph node is also evident.

In study patients, MRI findings suggestive of parametrial invasion included inhomogeneous signal intensity of cervical stroma seen in 42 (32.8%) patients, focal and complete disruption of hypointense cervical stromal ring on T2 weighted images seen in 35 (27.3%) patients, peritumoural fat stranding seen in 30 (23.4%) patients and tumour bulging into parametrial fat or the presence of soft tissue mass/tumour in parametrial tissue seen in 21 (16.4%) patients. (Table-3) (Figure-1 & 2).

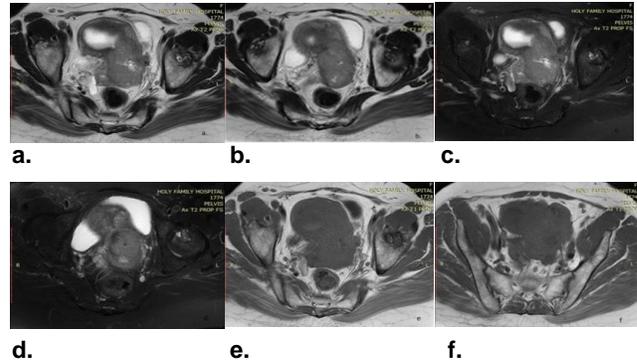


Figure 2: Axial T2WI (a,b) fat suppressed images (c,d) and TIWI (e,f) shows irregular margins of the cervix with linear stranding and spiculations of soft tissue mass radiating from periphery of cervical mass into the adjacent parametrial fat.

Discussion

In developing countries, cervical cancer remains one of the leading causes of deaths in women, most important factor being, over 80% of women with newly diagnosed cervical malignancy have an advanced disease at the time of presentation.¹⁸ However it was seen that in recent years, mortality due to cervical cancer has declined considerably especially in the developed world with good screening programs. Early detection is crucial for the patient as early stages of cervical malignancy can be treated by surgery. Chemotherapy and radiotherapy is usually reserved for patients with advanced stages of malignancy.¹⁹

Parametrial invasion is a very important factor in pre-operative evaluation of patients with cervical malignancy since it significantly influences management and treatment. MRI being non invasive, imaging modality and being free of ionizing radiations is a very important imaging tool for staging cervical cancer.

According to previous studies, imaging in transverse plane is important to look for parametrial tumour extension. It is also established that T2 weighted images are most important in detecting parametrial invasion of cancer.²⁰ In present study, MRI findings suggestive of parametrial invasion included inhomogeneous signal intensity of cervical stroma, focal and complete disruption of hypointense cervical stromal ring on T2 weighted images, peritumoural fat stranding and tumour bulging into parametrial fat or the presence of soft tissue mass/ tumour in parametrial tissue. The most frequent MRI finding was inhomogeneous signal intensity of cervical stromal ring followed by focal and complete disruption of stromal ring.

In present study, the sensitivity, specificity, positive predictive value, negative predictive value and accuracy of MRI in detecting parametrial invasion in patients with cervical malignancy was 84.5%, 84.2%, 86.9%, 81.3% and 84.3% respectively. Our study results are similar to already published studies. A similar study conducted that included 105 female patients with biopsy proven cervical cancer and determined the accuracy of MRI in detecting cervical stromal invasion keeping histopathology as gold standard. It was found that the sensitivity, specificity, PPV and NPV of MRI in diagnosing stromal invasion was 81.7%, 82.2%, 86% and 77.1% respectively which is in agreement with our study results.¹⁶ They also found that accuracy of MRI in detecting parametrial invasion in cervical carcinoma was not statistically significant according to age, marital status, locality and disease duration.¹⁶ Rigon G et al, in another study determined the diagnostic accuracy of MRI in carcinoma cervix. Specificity of MRI in detecting parametrial invasion was found to be 83.6% which is in agreement with the present study results.²¹

Several studies conducted recently have thus found that MRI is an important, reliable and accurate imaging modality for evaluation of parametrial tumour extension in patients with carcinoma cervix.^{16,20,21} In present study as well, MR imaging had a high accuracy in demonstrating parametrial invasion of cervical carcinoma.

MRI is a reliable and non-invasive imaging modality that allows the detection of parametrial invasion in patients of cervical cancer with sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy of 84.5%, 84.2%, 86.9%, 81.3% and 84.3% respectively.

Conflict of interest: None declared.

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