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Radio Diagnosis

ACCURACY OF MAGNETIC RESONANCE IMAGING (MRI) IN STAGING OF ENDOMETRIAL CARCINOMA

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ABSTRACT **Aim:** To determine the sensitivity, specificity and diagnostic accuracy of MRI in preoperative staging of biopsy proven endometrial cancer.

Background: Endometrial carcinoma (EC) is the most common gynecological malignancy world wide and second most common gynaecological malignancy among Indian women. The identification of disease extent prior to surgery is important to optimize treatment decision making. In this study, we are evaluating the accuracy of MRI in endometrial carcinoma staging and to evaluate the added value of diffusion-weighted imaging (DWI) in the preoperative assessment of myometrial invasion in endometrial cancer, in comparison with dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI).

Materials and Methods: 57 women with biopsy proven endometrial cancer underwent preoperative 1.5 T MRI. Interpretation of stage of the cancer was done using T2WI, DCE-MRI+T2WI, and DWI+T2WI and compared with histopathology findings. Accuracy, sensitivity, specificity, positive predictive value, and negative predictive value were calculated.

Results: MRI has good accuracy in overall staging of endometrial cancer. Highest accuracy was for stage IIIc1, IIIc2, IVa (100%) and the lowest was for Stage Ia (94.7%). Concerning assessment of depth of myometrial invasion, which has a pivotal role in surgical planning and decision for lymphadenectomy, T2/DWI (Acc: 92.9%) is more accurate than T2/DCE (Acc: 78.9%).

Conclusion: MRI is an accurate modality for preoperative assessment in endometrial cancer and can significantly assist in surgical planning. The addition of DWI apparently improves the diagnostic accuracy of MRI in the preoperative assessment of the depth of myometrial invasion in endometrial cancer, which may be particularly helpful in patients for whom contrast agents are contraindicated.

KEYWORDS : Endometrial carcinoma, Diffusion weighted imaging, Magnetic Resonance Imaging, Staging.

INTRODUCTION

Endometrial carcinoma (EC) is the most common gynecological malignancy world wide (1). In developing countries, it is the second most common gynecologic malignancy with an incidence of 5.9 per 100,000 women. In india the incidence is about 4.3 per 100,000 women (2). EC is more common in 6th and 7th decades of life with mean age of 65 years. Obesity, diabetes mellitus, unopposed estrogen intake, nulliparity, stein leventhal syndrome, lynch syndrome and tamoxifen therapy are known risk factors (3-5). Staging of the disease is done by revised FIGO staging guidelines. With the aid of imaging techniques, this is becoming more precise. MRI has an excellent tissue resolution enabling it to assess the intrauterine propagation of the tumour even at early tumour stage. Endometrial cancer is surgically staged and while surgery is the primary treatment modality, the identification of disease extent prior to surgery is important to optimize treatment decision making. Intraoperative visualization techniques, such as sentinel lymph node mapping, are increasingly used in recent days to avoid extensive surgical staging without compromising the treatment (6,7).

Imaging is also used for planning the adjuvant treatment and detection of the postoperative residual disease in high– risk patients, monitoring and in detecting recurrent disease, and post– treatment surveillance of asymptomatic patients with high risk of relapse/metastases (8-10). Preoperative MR imaging helps to evaluate the extent and staging of endometrial carcinoma, helping the surgeon to plan for surgery accordingly and thus aiding in the prognosis of the disease (10-12). Depth of myometrial invasion is one of the most important prognostic factors in EC (13-16).

The rationale of the study was to assess the role of preoperative MRI in endometrial carcinoma staging, following the MRI protocols used in our hospital, so that it can aid in the management and surgical decision.

MATERIALS AND METHODS:

Institutional Review Board approval was taken for this prospective study. Informed consent was taken from all the patients before they underwent MRI. 57 patients undergoing MRI for preoperative staging of biopsy proven endometrial cancer, regardless of age or comorbidities were included in the study. Patients with contraindication to MR imaging, not willing for MR imaging, not willing for surgery, deferred from surgery and patients lost on followup were excluded from the study.

Technique:

MRI imaging was performed (after verbal consent) with a 1.5T MR Imaging HDXT Machine, GE Medical Systems, Milwaukee, Wisconsin using our standard protocol. The protocol included axial and sagittal T2-weighted imaging, axial and sagittal DWI and sagittal post-intravenous gadolinium chelate, DOTAREM® (gadoterate meglumine) dynamic contrast-enhanced sequences with a screening abdomen with axial FIESTA and axial LAVA delayed. MR imaging was performed with patient lying in the supine position. Ax DWI and sag DWI are taken at b 500 and b 800. The dynamic contrast is performed with 20 ml of contrast at 1.5ml/sec, 3 Phases are taken one at 30sec, one at 44 sec and the last at 1.30min.

Image interpretation:

Criteria for myometrial invasion:

One of the most important prognostic factors, the depth of myometrial invasion was determined separately in all patients. The demonstrability of the myometrial invasion was separately evaluated for combined T2-weighted/DWI and combined T2/DCE sequences.

On T2 - EC is intermediate signal intensity than normal endometrium.
DWI - EC shows high signal intensity

DCE -EC enhances less than the normal myometrium
The myometrial invasion depth was defined as the distance between the inner myometrial interface and the invasion point. We categorized invasion depth of <50% of the myometrial thickness as <50%invasion, and extension into outer half of the myometrium as >50% invasion.

Criteria for cervical involvement:
T2 - disruption of normal low SI of cervical stroma by intermediate SI of tumour.
DWI –EC has high SI.
DCE- interruption and disruption of normal enhancement of cervical stroma.

Criteria for serosa of uterus and/or adnexa involvement: Disruption or irregular uterine contour caused by tumour

Criteria for vagina or parametrial involvement: Direct tumour extension of tumour into serosa and upper vagina or/and parametrial tissues.

Criteria for pelvic or para aortic lymph nodes: >8mm (pelvic) and >10 mm (para aortic) in short axis are considered as metastatic.

Criteria for bladder/bowel mucosal involvement: Tumour disrupting bladder or bowel muscle and invading mucosa.

Criteria for distant metastases: Tumour deposits at distal sites including peritoneal mets, bladder, bone liver metastases and distal lymph node metastases

STATISTICALANALYSIS:
Statistical analysis was performed using IBM SPSS version 20.0 software. Categorical variables were expressed using frequency and percentage. Numerical variables were presented using mean and standard deviation. To test the statistical significance of the comparison of all MRI parameters with histopathology McNemar's Chi-square test was used and the agreement was found using Cohen's Kappa. Diagnostic measures such as sensitivity, specificity, PVP, PVN and accuracy were calculated. A p value <0.05 was considered to be statistically significant.

RESULTS:
A total of 57 patients who fulfilled the exclusion and inclusion criteria and who underwent surgery for proven case of endometrial cancer, who had undergone MRI prior to surgery were included in the study. All the 57 patients with endometrial cancer underwent MRI. Histopathology was taken as the gold standard. Maximum number of patients were noted in the 60-69 years age group (42.10%) and least in the 40-49 years age group (5.3 %). Mean age of the study population was 62.18±8.625 years**.** Maximum age was 84 years and minimum age was 41 years. Out of the biopsy proven 57 cases of EC , majority were stage Ia tumours (26 out of 57), followed by stage Ib (18 out of 57), stage IIIc1 (5 out of 57), stage II (4 out of 57), stage IIIC2 (3 out of 57) and stage IVa (1 out of 57). MRI Staging was done incorporating all the findings of all sequences.

MRI has sensitivity, specificity and accuracy of 96%, 93% and 94% respectively for stage Ia and 88%,100% and 96% for stage Ib. MRI has sensitivity, specificity and accuracy of 100%, 98% and 98% respectively for stage II endometrial carcinoma. Sensitivity, specificity and accuracy of MRI in detecting stage IIIc1, IIIc2 and IV are 100%, 100% and 100% respectively (Table -1).

Table 1: Diagnostic parameters of MRI in assessing various stages of EC.

	Sensitivity (95%C.I)	Specificity (95%C.I)	PPV (95%C.I)	NPV (95%C.I)	ACCURACY (95%C.I)
Stage Ia	96.1% (80.3% to 99.9%)	93.5% (78.5% to 99.2%)	92.5% (76.5% to 97.9%)	96.6% (80.8% to 99.5%)	**94.7% (85.3% to 98.9%)**
Stage Ib	88.8% (65.2% to 98.6%)	100% (90.9% to 100%)	100%	95.1% (84% to 98.6%)	**96.4% (87.8% to 99.5%)**
Stage II	100% (39.7% to 100%)	98.1% (89.9% to 99.9%)	80.00% (36.4% to 96.5%)	100%	**98.2% (90.6% to 99.9%)**
Stage III C1	100% (47.8% to 100%)	100% (93.1% to 100%)	100%	100%	**100% (93.7% to 100%)**
Stage III C2	100% (29.2% - 100%)	100% (93.4% - 100%)	100%	100%	**100% (93.7% to 100%)**
Stage IV	100% (2.5-100 %)	100% (93.6 - 100 %)	100%	100%	**100 % (93.7% to 100%)**

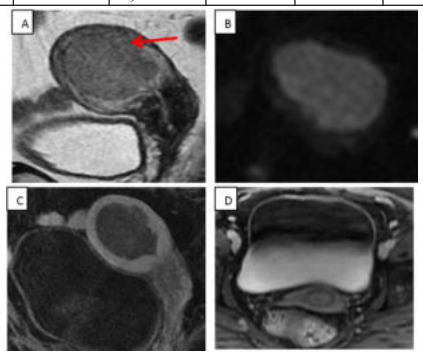

Figure 1: A 62 year old female with stage Ib endometrial carcinoma invading >50% of myometrium (A) Sag T2 image showing tumour invading outer half of myometrium (red arrow). Tumour is bright on corresponding axial DWI (B) and hypoenhancing on sagittal DCE images(C). No cervical stromal invasion in axial delayed contrast. (D)

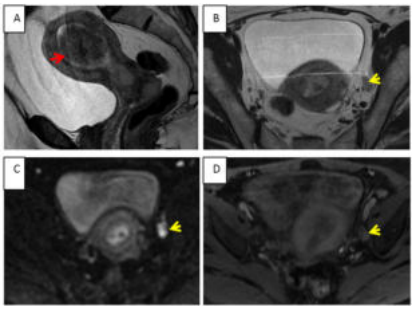

Figure 2: A 73 year old female with stage III C1 endometrial carcinoma with pelvic node involvement. (A) Sagittal and (B) Axial T2 images showing primary iso to hyper intense tumour (red arrow) with hypointense internal iliac node (B, yellow arrow) on left side (>8mm). (C) Tumour and left internal iliac node are bright on axial DWI image. (D) Hypointense tumour with enhancing left iliac node on axial delayed post contrast image.

Combined T2/DWI had a higher accuracy (92.9%) than combined T2/DCE (78.9%) in evaluation of deep myometrial invasion of EC. The sensitivity and specificity for T2/DWI (Se ; 90% and Sp: 96%) were also more than T2/DCE (Se :63% and Sp: 96%)(Figure-1).

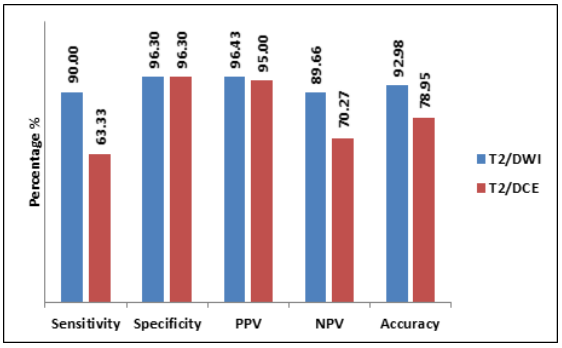

Figure 3: Bar diagram showing comparison of validity parameters of MRI – T2/DWI and T2/DWI in assessing > 50% myometrial invasion.

DISCUSSION:
Endometrial carcinoma is the second most common malignancy of the female genital tract among Indian women(1). In EC , depth of myometrial invasion is a crucial step in the preoperative MRI assessment and can help patient management strategy as it is clearly related to lymphnode metastasis, relapse rate and prognosis. Combined T2/DWI had a higher accuracy (92.9%) than combined T2/DCE (78.9%) in evaluation of deep myometrial invasion of EC.

The sensitivity and specificity for T2/DWI were 90% and 96% which were also better than T2/DCE (Sensitivity :63% and Specificity: 96%) (Figure-3). For assessment of myometrial invasion, Beddy et al.(4) reported that T2/DWI showed higher accuracy, sensitivity and specificity (90%,84% and 100%) than T2/DCE MRI (71%,61% and 88%) which nearly matched our study. Gil et al. (5) also reported high accuracy of fused T2/DWI (95 %) than T2/DCE (86%) in detecting >50% myometrial tumour invasion. Accuracy, sensitivity and specificity of MRI in detecting cervical stromal invasion were 98%, 100% and 97% respectively. Sampath et al. reported almost similar accuracy, sensitivity and specificity of 96%,100% and 97.9% respectively for MRI in detecting cervical stromal invasion (1). Deep myometrial invasion was seen in 8 out of 9 cases with nodal metastases. Only one case with nodal metastases had less than 50 % myometrial invasion. This further suggests the importance of imaging for predicting nodal involvement which can tailor the need for lymphadenectomy. Whether to do a pelvic lymphadenectomy along with hysterectomy is pivotal, as it causes more morbidity and mortality. Pelvic node involvement is FIGO stage IIIc1 and para aortic nodal involvement is FIGO stage IIIc2. These cases need extended lymphadenectomy. Enlarged pelvic nodes with short axis diameter (SAD) >8mm and para aortic nodes with short axis diameter (SAD) >10mm were considered as metastatic in this study (Figure-2).The accuracy, sensitivity and specificity for detecting pelvic and para aortic metastatic nodes was 100%. Previous studies by Hori *et al. (6)* and Rockall*et al*.(7) had reported an accuracy of 100 % for lymph node metastasis. There was almost perfect agreement between MRI and HPR in staging of endometrial carcinoma (k=0.945). MRI correctly staged 54 out of 57 cases of EC giving an overall accuracy of 94.7%. Similar study conducted by Guo et al. (10), MRI showed an overall accuracy of 94.8% (54/56) in staging endometrial ca. which is in concordance with our results. Most of the endometrial carcinomas are detected at an early stage and are curable by simple hysterectomy (8). The prognosis of endometrial cancer is more favorable compared to other gynecological malignancies. The histological grade, the stage of disease, depth of myometrial invasion, cervical involvement are predictive of the occurrence of extrauterine spread and pelvic or aortic nodal metastases (9). This in turn will affect prognosis and treatment. Based on the stage of the disease, the treatment options include surgery, radiation therapy, hormone therapy and chemotherapy. Surgery can be tailored based on the risk and chance of nodal involvement to avoid complications. Pre-treatment staging is crucial to define the type and extent of therapy. The good spatial resolution makes MRI ideal for discerning the complex pelvic anatomy with muscles and fascias and it scores over other imaging modalities in staging of endometrial carcinoma.

CONCLUSION:

MRI has good accuracy in overall staging of endometrial cancer with highest accuracy for Stage IIIc1, IIIc2, IVa. Concerning assessment of depth of myometrial invasion, which has a pivotal role in surgical planning and decision for lymphadenectomy T2/DWI is more accurate than T2/DCE.

REFERENCES:

1. Sampath, S., Nema, D., Agarwal, R., & Lele, P. Accuracy of MR Imaging in endometrial cancer: our experience. International Journal of Reproduction, Contraception, Obstetrics and Gynecology, 6(4), 1631.
2. Balasubramaniam, G., Sushama, S., Rasika, B., & Mahantshetty, U. (2013). Hospital-based study of endometrial cancer survival in Mumbai, India. Asian Pac J Cancer Prev, 14(2), 977-80.
3. Sala, E., Rockall, A., & Kubik-Huch, R. A. (2011). Advances in magnetic resonance imaging of endometrial cancer.
4. Beddy, P., Moyle, P., Kataoka, M., Yamamoto, A. K., Joubert, I., Lomas, D., ... & Sala, E. (2012). Evaluation of depth of myometrial invasion and overall staging in endometrial cancer: comparison of diffusion-weighted and dynamic contrast-enhanced MR imaging. Radiology, 262(2), 530-537.
5. Gil, R. T., Cunha, T. M., Horta, M., & Alves, I. (2019). The added value of diffusion-weighted imaging in the preoperative assessment of endometrial cancer. Radiologia Brasileira, 52(4), 229-236.
6. Hori, M., Kim, T., Murakami, T., Imaoka, I., Onishi, H., Nakamoto, A., ... & Kimura, T. (2009). MR imaging of endometrial carcinoma for preoperative staging at 3.0 T: comparison with imaging at 1.5 T. Journal of Magnetic Resonance Imaging: An Official Journal of the International Society for Magnetic Resonance in Medicine, 30(3), 621-630.
7. Rockall, A. G., Meroni, R., Sohaib, S. A., Reynolds, K., Alexander-Sefre, F., Shepherd, J. H., ... & Reznek, R. H. (2007). Evaluation of endometrial carcinoma on magnetic resonance imaging. International Journal of Gynecologic Cancer, 17(1).
8. Lien, H. H., Blomlie, V., Trope, C., Kaern, J., & Abeler, V. M. (1991). Cancer of the endometrium: value of MR imaging in determining depth of invasion into the myometrium. AJR. American journal of roentgenology, 157(6), 1221-1223.
9. Beddy, P., O'Neill, A. C., Yamamoto, A. K., Addley, H. C., Reinhold, C., & Sala, E. (2012). FIGO staging system for endometrial cancer: added benefits of MR imaging. Radiographics, 32(1), 241-254.
10. Foti, P. V., Farina, R., Coronella, M., Ruggeri, C., Palmucci, S., Montana, A., ... & Politi, G. (2013). Endometrial carcinoma: MR staging and causes of error. La radiologia medica, 118(3), 487-503.
11. Singh, N., Hirschowitz, L., Zaino, R., Alvarado-Cabrero, I., Duggan, M. A., Ali-Fehmi, R., ... & Matias-Guiu, X. (2019). Pathologic prognostic factors in endometrial carcinoma (other than tumor type and grade). International Journal of Gynecological Pathology, 38(1 Suppl 1), S93.
12. Kang, S., Todo, Y., & Watari, H. (2014). Risk assessment of lymph node metastasis before surgery in endometrial cancer: Do we need a clinical trial for low‐risk patients?. Journal of Obstetrics and Gynaecology Research, 40(2), 322-326.
13. Guo, Y., Wang, P., Wang, P., Gao, W., Li, F., Yang, X., ... & Guo, Z. (2017). Myometrial invasion and overall staging of endometrial carcinoma: assessment using fusion of T2-weighted magnetic resonance imaging and diffusion-weighted magnetic resonance imaging. OncoTargets and therapy, 10, 5937.
14. Manfredi, R., Mirk, P., Maresca, G., Margariti, P. A., Testa, A., Zannoni, G. F., ... & Marano, P. (2004). Local-regional staging of endometrial carcinoma: role of MR imaging in surgical planning. Radiology, 231(2), 372-378.
15. Duncan, K. A., Drinkwater, K. J., Frost, C., Remedios, D., & Barter, S. (2012). Staging cancer of the uterus: a national audit of MRI accuracy. Clinical radiology, 67(6), 523-530.
16. Hori, M., Kim, T., Murakami, T., Imaoka, I., Onishi, H., Nakamoto, A., & Kimura, T. (2009). MR imaging of endometrial carcinoma for preoperative staging at 3.0 T: comparison with imaging at 1.5 T. Journal of Magnetic Resonance Imaging: An Official Journal of the International Society for Magnetic Resonance in Medicine, 30(3), 621-630.