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Original Research Article

Efficacy of magnetic resonance imaging in assessment of myometrial invasion of carcinoma endometrium

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ABSTRACT

Background: Endometrial carcinoma is the fourth most common cancer in females and the most common malignancy of the female reproductive tract. The prognosis of endometrial carcinoma depends on a number of factors, including stage, depth of myometrial invasion, lympho-vascular invasion, nodal status and histologic grade. Preoperative assessment with MRI is essential for planning surgery and lymph node sampling. The objectives of this study were to determine the myometrial invasion of endometrial carcinoma by MRI and to obtain histopathology in surgically resected specimen, to compare the MRI findings of myometrial invasion in endometrial carcinoma with histopathology in respectable cases.
Methods: Authors analyzed 41 cases in whom, histopathological diagnosis of carcinoma endometrium was established by means of pre-treatment biopsy. Consenting patients were taken up for preoperative MRI FIGO staging. MR images were reviewed for parameters like depth of myometrial invasion. Further surgical management followed by histopathological FIGO staging was done.
Results: The study showed MRI was highly sensitive and specific tool for identifying depth of myometrial invasion, cervical invasion, serosal invasion, vaginal and parametrial invasion.
Conclusions: There was statistically significant difference between histopathological and MRI assessment of local invasion of endometrial carcinoma.

Keywords: Carcinoma endometrium, FIGO staging, Histopathology, Magnetic resonance imaging

INTRODUCTION

The endometrium which lines the uterine cavity is one of the most dynamic tissues in the human body. It is characterized by cyclical process of cell proliferation, differentiation and death in response to sex steroids elaborated in the ovary. Magnetic resonance imaging may accurately depict the extent of endometrial cancer at diagnosis and in conjunction with the tumor grade and histologic subtype, help stratify risk which determines the therapeutic course.[1] Concurrently MRI due to its excellent soft tissue contrast resolution, which exceeds that of CT scanning and ultrasonography is slowly gaining momentum in pretreatment evaluation of cancer endometrium. MRI is valuable in assessment of the size of tumor, the depth of myometrial invasion, cervical and vaginal invasion and also the involvement of serosa and parametrium. Patients with 50% or greater myometrial invasion have a six to seven-fold higher prevalence of pelvic and paraaortic lymph node metastasis compared with patients in whom myometrial invasion is absent or less than 50%.[2] Therefore, preoperative knowledge of this

factor represents a critical step in treatment planning and the surgical approach.[3] Using 2009 FIGO classification increases the accuracy of pelvic MR imaging for preoperative staging of patients with early stages of endometrial cancer (Table 1).

Table 1: The international federation of gynecology and obstetrics (FIGO) staging criteria (2009).

Stage	Description
I	Tumor confined to corpus uteri.
Ia	No or less than half (<50%) myometrial thickness.
Ib	Invasion equal to or more than half (>50%) of the myometrium.
II	Tumor invades cervical stroma but does not extend beyond the uterus.
III	Local and/or regional spread of the tumor
IIIa	Tumor invades the serosa of the corpus uteri and/or adnexa.
IIIb	Vaginal and/or parametrial involvement
IIIc	Metastases to pelvic or paraaortic lymph nodes.
IIIc1	Positive pelvic nodes.
IIIc2	Positive para aortic nodes with or without pelvic nodes.
IV	Involvement of rectum and/or bladder mucosa and/or distant metastasis.
IVa	Bladder or rectal mucosa involvement
IVb	Distant metastases, malignant ascites, peritoneal involvement.

METHODS

A 41 consenting patients with pathologically proven but untreated carcinoma endometrium referred to Amala Institute of medical sciences for pretreatment staging were taken up for preoperative MRI FIGO staging.

MR images were reviewed for parameters like depth of myometrial invasion, cervical invasion, serosal invasion, vaginal and parametrial invasion. Further surgical management followed by histopathological FIGO staging was done.

The MRI findings were compared with histopathologic findings and the accuracy of MRI in assessment of local invasion of carcinoma endometrium was studied. Descriptive study with diagnostic test evaluation.

Inclusion criteria

- Untreated cases of endometrial carcinoma among patients belonging to 35-70 years age group, diagnosed by fractional curettage, and referred to our department for pre-treatment MRI staging, who are taken up for resection subsequently,
- Only patients with stage I of endometrial carcinoma are included in the study.

Exclusion criteria

- Cases of endometrial carcinoma who are referred for follow up imaging,
- Patients with MRI incompatible implants,
- Patients with claustrophobia.

Statistical analysis

Descriptive statistical analysis has been carried out. Results on continuous measurements are presented on Mean±SD (Min-Max) and results on categorical measurements are presented in number (%). Significance is assessed at 5% level of significance. The following assumptions on data was made, assumptions: dependent variables should be normally distributed, samples drawn from the population should be random, chi-square/ fisher's exact test was used to find the significance of study parameters on categorical scale between two or more groups. Diagnostic statistics viz. sensitivity, specificity, PPV and NPV was calculated.

MRI protocol

The images were acquired as per the standard protocol for pelvis in our department in 1.5T MRI (GE SIGNA HDxT). The imaging protocol consists of T1 and T2 Weighted fast spin echo images in sagittal, modified axial and coronal planes. T2 fat suppressed images will be acquired in addition in axial plane. The axial images will be acquired in a plane perpendicular to the axis of the uterine body and the coronal and sagittal planes were taken in orthogonal planes parallel to the axis of the uterine body. T1 weighted postcontrast fat suppression images will be obtained in all three mentioned planes. A T2 coronal sequence covering the whole abdomen including bilateral kidneys and liver will be performed as a final sequence.

The imaging parameters in T1 weighted image are 620/15 ms repetition time (TR)/echo delay time (TE), field of view (FOV) 43 cm, matrix size 512 x 512 and in T2 weighted image are: 9620/102 ms (TR/TE), FOV 45 cm and matrix size 512 x 512. The average scan time is about 45 minutes. MR images will be evaluated and decision on findings will be taken by consensus in the department of Radiodiagnosis. MR images of all patients enrolled in the study were collected and assessed from picture archiving and communication system (PACS). Basic patient data and histology results were collected from the institutional medical archive system. Histopathological diagnosis of the disease was established by means of pretreatment biopsy. A written informed consent was taken from all patients taking part in the study.

Statistical analysis

Fishers' exact test p value=0.0001, sensitivity=72.7%, specificity=96.6%, positive predictive value=88.8%, negative predictive value =90.6%.

RESULTS

A total of 41 biopsy proven cases of carcinoma endometrium were included in present study. All these patients underwent MRI in our department. The results of the study are presented below.

Table 2: Age at presentation.

Age	Frequency	Percent
≤45	3	7.3
46-50	6	14.6
51-55	7	17.1
56-60	4	9.8
61-65	12	29.3
≥66	9	22.0
Total	41	100.0

Mean age = 58.63±8.151 years

Present study population included subjects whose age ranged from 45 to 70 years with mean age being 58.63±8.151 years. Authors grouped at age group of 5 years starting from 45 for analysis. Patients aged more than 65 years were grouped together. The data is presented as (Table 2). Carcinoma endometrium is predominantly affecting the elder women and less so the younger women. Therefore, the risk of developing endometrial cancer increases with advancing age.

Table 3: Chief complaints at presentation.

Clinical history	Frequency	Percent
Post-menopausal bleeding	23	56.1
Blood stained discharge pervaginum	9	22.0
Pelvic Pain	6	14.6
Dyspareunia	2	4.9
Menorrhagia	1	2.4
Total	41	100.0

The major presenting complaint among the studied population was post-menopausal bleeding. A total of 23 patients out of 41 cases (56.1%) presented with post-menopausal bleeding. Blood stained discharge per vaginum followed by pelvic pain were other chief complaints as 9 (22%) and 6 (14.6%) cases each respectively out of 41 patients. Dyspareunia and Menorrhagia were the least common major complaint, where 2 patients (4.9%) and 1 patient (2.4%) respectively presented with this symptom. The data is presented as (Table 3).

Table 4: Distribution of marital status.

Marital status	Frequency	Percent
Married	38	92.7
Unmarried	3	7.3
Total	41	100.0

An analysis on marital and parity status of the patient in the study showed that carcinoma endometrium was most prevalent among married woman and among woman with low parity (Table 4 and 5).

Table 5: Distribution of parity status.

Parity	Frequency	Percent
Zero	23	60.6
One	13	34.2
Two	1	2.6
Three	1	2.6
Total	38	100

Endometrial thicknesses of patients in the study was analyzed using MRI and most of the patients was found to have a value ranging from 1 to 4 cm (Table 6).

Table 6: Endometrial thicknesses patients with endometrial carcinoma in magnetic resonance imaging (MRI).

Endometrial thickness (cm)	Frequency	Percent
<1	2	4.9
1 to 2	18	43.9
2.1 to 3	9	22.0
3.1 to 4	10	24.4
4.1 to 5	1	2.4
5.1 to 6	1	2.4
Total	41	100.0

The appearances and enhancement patterns of the lesions are shown below in tabular form.

Most of the lesions appeared isointense in T1WI, hyperintense in T2WI and were hypo enhancing following contrast administration (Table 7, 8 and 9).

Table 7: Distribution of intensity of endometrial carcinoma in T1 weighted images.

Intensity in T1WI	Frequency	Percent
Isointense	17	41.5
Hypointense	14	34.1
Hyperintense	1	2.4
Hetero-intense	9	22.0
Total	41	100.0

Table 8: Distribution of intensity of endometrial carcinoma in T2 weighted images.

Intensity in T2WI	Frequency	Percent
Isointense	1	2.4
Hypointense	4	9.8
Hyperintense	29	70.7
Hetero-intense	7	17.1
Total	41	100

Table 9: Distribution of enhancement pattern in endometrial carcinoma.

Enhancement pattern	Frequency	Percent
Homogeneous enhancement	2	4.9
Hypo-enhancing	27	65.9
Heterogeneous enhancement	12	29.3
Total	41	100.0

Table 10: Distribution of depth of myometrial invasion with magnetic resonance imaging (MRI).

Depth of myometrial invasion	Frequency	Percent
Less than 50%	9	22.0
More than 50%	32	78.0
Total	41	100.0

Table 11: Distribution of depth of myometrial invasion with histopathology.

Depth of myometrial invasion	Frequency	Percent
Less than 50%	16	39.0
More than 50%	25	61.0
Total	41	100.0

Table 12: Distribution of depth of myometrial invasion with histopathology.

Depth of invasion of myometrium	Involvement of less than 50% of myometrium in histopathology	Involvement of more than 50% of myometrium in histopathology	Total
Involvement of less than 50% of myometrium in MRI	8	1	9
Involvement of more than 50% of myometrium in MRI	3	29	32
Total	11	30	41

DISCUSSION

Appearance of normal endometrium in MRI

The corpus uterus is a complex organ dedicated to reproduction, traditionally divided on an anatomico-histologic basis into two clearly distinct parts-the endometrium and myometrium. In 1983, Hricak et al, delineated the normal zonal anatomy on MRI.[4]

The term "junctional zone" was introduced in this manner to describe this interface observed on MRI: a distinct low signal on T2 weighted sequences separating the endometrium in high signal intensity from the outer myometrium in intermediate signal (Figure 1).

MR evaluation of depth of myometrial invasion of endometrial carcinoma

In T2 weighted imaging, myometrial invasion was detected by disruption or discontinuity of the junctional zone and its depth was determined by the extent of the tumor signal intensity extending into the myometrium.[5,6] In patients whom the junctional zone was not visible on MRI, the presence of a smooth endometrium-myometrium interface was considered a reliable indicator of noninvasive tumor.

Absent invasion was diagnosed when a clear and uninterrupted junctional zone could be identified and in cases where no junctional zone was visible, the presence of a smooth endometrium-myometrium interface was considered a reliable indicator of noninvasive tumor.

Superficial invasion was diagnosed when the junctional zone was interrupted and when the border between the endometrium and the myometrium was irregular with tumor signal extending to less than 50% of the myometrial thickness. Deep invasion was diagnosed when the junctional zone or myometrial border was interrupted with tumor signal extending beyond 50% of the myometrial thickness.

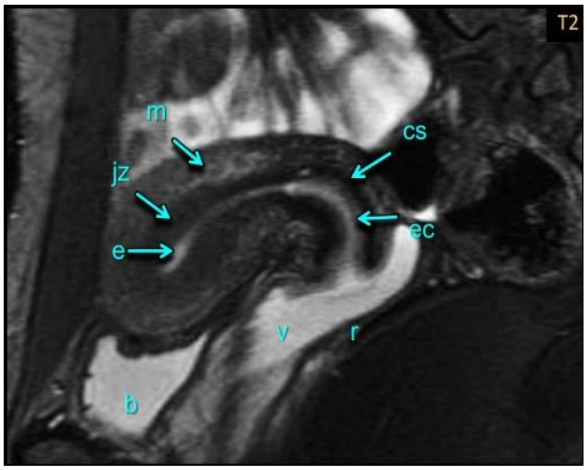

Figure 1: Sagittal T2 weighted fat saturated image demonstrates the normal trilaminar appearance of the uterus. The T2 hyperintense endometrium (e), the hypointense junctional zone (jz), and isointense myometrium (m) creates the trilaminar appearance. The cervix demonstrates a hyperintense endocervical canal and hypointense cervical (cs) stroma. Bladder (b), vagina (v), rectum (r).

On T1 weighted post contrast fat suppression images, an intact sub endometrial enhancement (SEE) band indicated no myometrial invasion. In cases where a SEE band was not visible, a smooth tumor to myometrium interface indicated that the tumor was confined to the endometrium. Superficial myometrial invasion was diagnosed when the SEE was interrupted or the interface between tumor and myometrium was irregular, with low signal intensity tumor extending to involve less than 50% of myometrial thickness (Figure 2 and 3).

Extension of low signal intensity tumor beyond 50% of the myometrium thickness was indicative of deep myometrial invasion (Figure 4 and 5).[7]

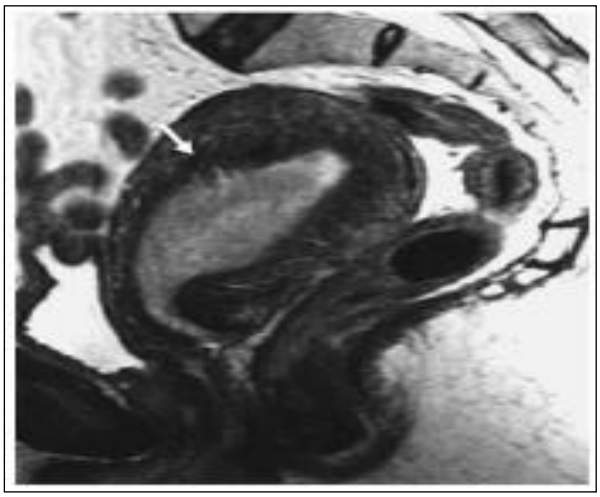

Figure 2: Carcinoma endometrium stage Ia on sagittal T2W image.

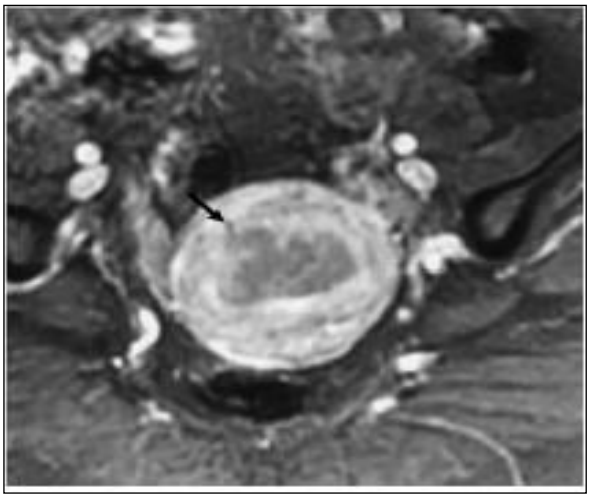

Figure 3: Carcinoma endometrium stage Ia on coronal T1 weighted post contrast fat suppression image.

Figure 4: Carcinoma endometrium stage Ib on coronal T2W image.

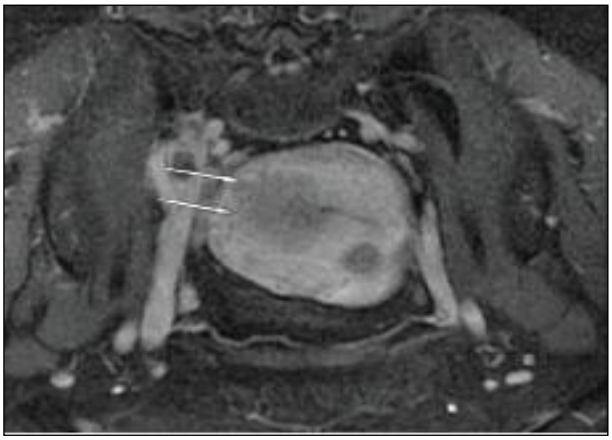

Figure 5: Carcinoma endometrium stage Ib on coronal T1 weighted post contrast fat suppression image.

When authors analyzed the data on presentation pattern of Ca endometrium, the most common was per vaginal bleeding in post-menopausal period. The data on parity status of the cases showed that lower parity was associated with a higher risk of developing endometrial carcinoma. This is in accordance with the data published by Lau S et al.[8] Majority of the lesions in MRI appeared iso to hypointense in T1WI irrespective of the histological types. On T2 weighted sequences, majority of the cases demonstrated hyperintense signal intensity of the lesions. Iso to hypointense lesions were noted in rest of the cases. This finding was similar to the study undertaken by Lee EJ et al.[9] Contrast enhanced T1W fat suppressed images showed that majority of the lesions showed hypo enhancement in accordance with the data published Seki H et al.[10] In the study by Zamani F et al, the evaluation of deep tumoral invasion of the myometrium (>50%), sensitivity, specificity, diagnostic accuracy and positive and negative predictive values of MRI were 82.35%, 94.59%, 90.74%, 87.5% and 92.1%, respectively.[11] Accurate determination of the presence of deep myometrial invasion is a vital factor because it is directly related to the incidence of lymph node metastases, length of time to recurrence and overall prognosis. Patients with no invasion or superficial myometrial invasion do not require a full staging procedure. In addition, preoperative MRI allows the clinician to plan the proper management.

CONCLUSION

There was statistically significant difference between histopathological and MRI assessment of local invasion of endometrial carcinoma. MRI proved to have excellent specificity (96.6%) and an NPV of 90.6% in evaluation of depth of myometrial invasion.

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