Stage I Endometrial Carcinoma: Value of MR Imaging in Determining Depth of Myometrial Invasion

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Purpose: In patients with endometrial carcinoma, preoperative knowledge of myometrial tumor extension has important prognostic and therapeutic implications. The purpose of this study was to assess the usefulness of magnetic resonance (MR) imaging in preoperative evaluation of myometrial invasion of early stage endometrial carcinoma.

Materials and Methods: MR imaging findings of 31 consecutive patients with histologically proved endometrial carcinoma, were prospectively analyzed and compared with pathologic results. Myometrial invasion was classified into three groups: absence of myometrial invasion, superficial and deep invasion in accordance with clinical stage IA, IB, IC respectively.

Results: MR imaging had an accuracy of 74.2%, a sensitivity of 85.7%, and a specificity of 70.8% in stage IA (n=7): 67.7%, 46.2%, 83.3% in stage IB (n=13): 93.5%, 81.8%, 100% in stage IC (n=11) respectively. Overall accuracy was 79.9%. Nine of ten incorrect cases were underestimated, and one was overestimated. Degree of invasiveness was underestimated in cases with adenomyosis, small tumor showing focal wall thickening, and faint junctional zone in postmenopausal women.

Conclusion: The results of this study show that MR imaging can be used to distinguish superficial and deep penetration of myometrium in endometrial carcinoma.

Index Words: Uterine neoplasms, MR Uterine neoplasms, staging

INTRODUCTION

In endometrial carcinoma even with disease apparently limited to the uterus, survival may be affected by several factors, including histologic tumor grade and depth of myometrial tumor invasion. Both of them correlate with the prevalence of lymph node metastasis. Abeler reported that the depth of myometrial invasion was the most important prognostic factor in his study of 1566 patients with endometrial carcinoma(1). Although histopathology and tumor grade may be determined by diagnostic curettage prior to surgery, myometrial invasion could be evaluated only after hysterectomy. Recently, magnetic resonance (MR) imaging has become the imaging technique of choice for evaluating myometrial invasion of endometrial carcinoma(2, 3). On the basis of MR imaging results, in patients with deep myometrial invasion and at high risk for lymph node metastasis, preoperative radiation therapy or chemotherapy would be indicated.

We assessed the value of MR imaging in determining myometrial invasion in stage I endometrial carcinoma.

MATERIALS and METHODS

This study was based on 31 consecutive patients (aged 36–67 years, mean: 52.9 years) with histologically verified endometrial adenocarcinoma between October 1991 and March 1994. Twenty-two patients were postmenopausal and nine were premenopausal. No patient had previously received chemotherapy or radiation therapy. Clinical stage of all patients was stage I according to the classification system of the Inte-
Myometrial spread was classified as absent (stage IA), superficial (stage IB, less than 50% of myometrial thickness) and deep (stage IC, 50% or more of myometrial thickness). Patients with disease at other stage were excluded from the study because in those cases radiation therapy would be the treatment of choice and consequently no pathologic specimens could be obtained to be compared with.

MR images were obtained within two weeks before surgery. MR examination was performed with a 1.0 T unit (SMT-100 X, Shimadzu, Japan). The matrix size was 256 x 256, with a 28 cm field of view, and the data were displayed in a 256 x 256 matrix. The section thickness was 5 mm with an intersection gap of 2 mm. T1-weighted [(500-700/20-30 (TR/TE)] and T2-weighted [2000-2500/80-95 (TR/TE)] spin-echo images were obtained in sagittal and axial planes with two signal average. Gadolinium-enhanced T1-weighted images were added in both axial and sagittal planes. After rapid bolus injection of Gadopentetate dimeglumine (2cc/kg of body weight), MR images were obtained 10 minutes later.

MR images were analyzed in terms of location and size of tumor, depth of myometrial invasion, endocervical extension, and detection of any associated diseases such as leiomyoma, adenomyosis. On MR images, tumor was identified as enhancing mass and high signal intensity attached to endometrial surface. Tumor confined to the endometrium was diagnosed when the low signal intensity band around tumor (junctional zone) appeared to be intact. Myometrial invasion was diagnosed in the case of segmentally disrupted junctional zone on axial or sagittal T2-weighted images. In patients in whom the junctional zone was indistinct, the presence of a smooth interface between endometrium and myometrium was considered a reliable sign that the myometrium was not involved with the tumor. Conversely, irregular endometrium-myometrium interface was considered a sign of myometrial invasion(5).

All patients underwent primary surgery including a thorough exploratory staging, total abdominal hysterectomy, bilateral salpingo-oophorectomy, and selective biopsy of paraaortic and pelvic nodes.

MR imaging findings were compared with pathologic results of these surgical specimens.

### Table 1. MR Imaging Stage vs Pathology Stage in Endometrial Carcinoma

<table>
<thead>
<tr>
<th>Patho \ MR</th>
<th>IA</th>
<th>IB</th>
<th>IC</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>IB</td>
<td>7</td>
<td>6</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>IC</td>
<td>0</td>
<td>2</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td>9</td>
<td>9</td>
<td>31</td>
</tr>
</tbody>
</table>

On pathologic examination, the stage of the tumor was IA in 7 cases, IB in 13, and IC in 11. Average tumor size of tumor was 7 cases. IB in 13, and IC in 11. Average tumor size of tumor was 7 cases.
size was 1.1 cm in the stage IA cases, 1.5 cm in stage IB and 5.0 cm in stage IC.

Twenty-one patients (67.7%) were correctly staged with MR imaging, and ten (32.3%) were incorrectly staged (Table 1). Errors in determining the depth of myometrial tumor invasion were underestimation in nine and overestimation in one.

In stage IA (n=7), six were correctly staged and one was overestimated as stage IB. In that case, pathologic result showed no residual mass but cellular debris and blood clot (Fig. 1). In stage IB (n=13), only six were correctly assessed and the remaining seven were underestimated as stage IA. Those underestimated cases revealed coexisting adenomyosis (n=1) (Fig. 2), leiomyoma (n=2), and focal infiltrative lesion (eg. microinvasion) (n=4). In stage IC (n=11), nine were correctly staged with MR images (Fig. 3). Remaining two were underestimated as stage IB. Both of them revealed faint junctional zone on MR imaging.

MR imaging had an accuracy of 74.2%, sensitivity of 85.7% and specificity of 70.8% in stage IA; 67.7%, 46.2%, 83.3% in stage IB; 93.5%, 81.8%, 100% in stage IC, respectively (Table 2). Overall accuracy was 79.9% in the assessment of myometrial invasion of endometrial carcinoma.

**DISCUSSION**

Endometrial carcinoma is uncommon malignant neoplasm in Korea, accounting for 1.6% of all malignant neoplasm of female genital tract(6). Endometrial carcinoma is, however, the third most common malignancy arising in female genital tract, following cervical carcinoma and ovarian carcinoma. Endometrial carcinoma tends to be diagnosed at early stage due to abnormal vaginal bleeding. The high cure rate for localized endometrial carcinoma has emphasized the importance of early detection and treatment.

MR imaging is widely accepted as an useful diagnostic tool for women with pelvic tumor. Because of its capacity to produce multiplanar images and its unsurpassed soft tissue contrast, MR imaging is superior to ultrasonography or computed tomography for determining the extent of uterine masses(3, 7). In endometrial carcinoma, contrast between carcinoma and normal endometrium is accentuated on MR image. Detection of small tumors confined to endometrium is possible on enhanced images(3, 8, 9). Furthermore, the enhanced sequences allowed better assessment of myometrial invasion (5, 9).

| Table 2. Diagnostic Accuracy of MR Imaging in Stage I Endometrial Carcinoma (%) |
|-----------------|----------------|---------------|-----------------|---------------|-----------------|
| Stage           | Accuracy       | Sensitivity   | Specificity     | PPV  | NPV             |
| IA (n=7)        | 74.2           | 85.7          | 70.8            | 46.2 | 94.4            |
| IB (n=13)       | 67.7           | 46.2          | 83.3            | 66.7 | 68.2            |
| IC (n=11)       | 93.5           | 81.8          | 100             | 100  | 90.9            |

*PPV: positive predictive value
NPV: negative predictive value

**Fig. 2.** a, b. Stage IB endometrial carcinoma.
a. Transaxial T2-weighted (SE 2000/80) image shows a small endometrial tumor (short arrow) and underlying focal adenomyosis (curved arrow). Underlying adenomyosis obscures the presence of myometrial invasion.
The depth of myometrial penetration is an important prognostic factor. Depth of myometrial invasion strongly correlates with the presence of lymph node metastases. The incidence of pelvic lymph node metastases varies with depth of myometrial invasion as follows: tumor limited to endometrium only (1%), superficial invasion (5%) and deep invasion (31%). The incidence of aortic lymph node metastases varies with depth of myometrial invasion approximately as follows: tumor limited to endometrium only (1%), superficial invasion (3%), deep invasion (18%) (10).

In evaluating myometrial invasion with T2-weighted MR images, accuracy has been reported in range of 74-87% (2, 7, 11, 12). MR concordance with histologic examination is about 80% for staging endometrial carcinoma and 82% for distinguishing superficial from deep myometrial invasion (2). Contrast-enhanced MR imaging may be indicated for correct interpretation of myometrial invasion in preoperative assessment of endometrial carcinoma (3). Lien et al reported MR accuracy in deep invasion was 82%, with sensitivity of 91% and specificity of 64% (11). Sironi et al reported a sensitivity and specificity of MR assessment in stage I endometrial carcinoma; 57%, 16% in stage IA, 74%, 74% in stage IB, 88%, 85% in stage IC, respectively (13). The accuracy of MR imaging in our study (79.9%) was similar to the results of other authors.

In our cases which were incorrectly staged, all but one were understaged. Two cases of deeply invasive tumor were understaged as superficial invasion on MR images. Remaining seven cases of superficial myometrial invasion were underestimated as cases of no myometrial invasion. In these cases, the presence of adenomyosis or leiomyomas seemed to be a factor interfering with accurate MR interpretation. The presence of polypoid tumors that induced marked deformity of the uterine cavity was mainly responsible for such MR errors (13). Other factors were the small tumor showing focal wall thickening and retained fluid in endometrial cavity. Minimal or microscopic invasion was the most common reason for underestimating myometrial invasion, regardless of the imaging technique (3).

In one case, the cause of overestimation was probably hyperplastic myometrium and blood clot. Presence of myoma or distended endometrial cavity sometimes complicated the assessment of myometrial invasion (3, 11). Endometrial hyperplasia, submucosal leiomyoma, blood clots may increase the endometrial thickness or widen the uterine cavity, simulating endometrial carcinoma (2).

Endometrial carcinoma usually occurs in postmenopausal women in whom the junctional zone is faint. This factor complicated the assessment of myometrial invasion as well. Although, MR imaging showed low specificity for tumor detection, it showed high accuracy in staging of histologically documented endometrial carcinoma (2).

This study concluded that MRI was a very useful diagnostic tool in assessing the depth of myometrial invasion in stage I endometrial carcinoma.

REFERENCES

제 I 기 자궁내막암의 근층침범 진단에 있어서 MRI의 유용성

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목 적: 자궁내막암 환자에서 자궁근층 침범정도는 환자의 예후를 판정하거나 치료방침을 결정하는데 중요한 요소이다. 저자들은 자궁내막암 환자에서 근층 침범여부와 그 침범된 깊이를 진단하는데 있어 자기공명영상 (MRI) 의 유용성을 알고자 전향적 연구를 시행하였다.

대상 및 방법: 자궁내막암으로 진단받은 31명의 환자에서 MRI 소견을 분석하여 근층 침범여부 및 그 정도를 판정하고 수술후 병리소견과 비교하였다. 근층침범 정도는 FIGO Staging과 일치하도록 자궁내막층에 국한된 경우, 자궁근층의 50% 미만이 침범된 경우, 자궁근층의 50% 이상이 침범된 경우로 분류하여 진단하였다.

결 과: MRI 소견에 의한 근층침범 진단의 정확도, 민감도, 특이도는 Stage IA 환자에서 74.2%, 85.7%, 70.8% 이고 Stage IB에서 각각 67.7%, 46.2%, 83.3%, Stage IC에서 93.5%, 81.8%, 100% 이었다. MRI소견상 부정확한 예측을 보인 10예중 9예에서 understaging이었으며 그 원인으로는 동반된 자궁내막증, 자궁근증, 혈종등에 의한 근층의 변형때문이거나 나이가 많은 환자에서 junctional zone의 불명확한 때문이었다.

결 론: MRI는 자궁내막암의 근층 침범정도를 진단하는데 매우 유용하나, 특히 동반된 자궁질환이 있는 경우엔 판정에 주의해야 한다.
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