

Comparison of preoperative magnetic resonance imaging results with postoperative pathologic results in early stage uterine cervical cancer

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Summary

Objective: To compare the preoperative magnetic resonance imaging (MRI) findings of early stage cervical cancer patients with their postoperative histopathologic results. **Materials and Methods:** This is a retrospective study evaluating oncology charts of 30 early-stage cervical carcinoma patients who were diagnosed and underwent surgery between July 2006 to August 2011 at the present institution. Preoperative MRI staging, clinical staging, and histopathologic staging results were compared. **Results:** Seven patients had clinically correct stage and 20 patients had correct MRI staging according to histopathology. MRI staging revealed 66% sensitivity and it was strongly correlated with pathologic staging. Cervical ring invasion was present in 20 patients pathologically, whereas 13 patients were diagnosed positive on MRI evaluation. Among ten patients without cervical ring invasion, MRI diagnosed six of them correctly. Of the 11 positive parametrial invasion patients diagnosed pathologically, MRI ruled out only seven of them. **Conclusion:** Preoperative MRI staging might be a better tool to stage cervical cancer than clinical staging. MRI evaluates parametrial invasion and cervical ring involvement appropriately.

Key words: Magnetic resonance imaging; Uterine cervical cancer; Tumor staging; Histopathology.

Introduction

Cervical cancer is the second most common cancer in women after breast cancer. Despite routine follow-up protocols, it is still the most fatal gynecologic cancer worldwide [1, 2]. Cervical cancer staging is unique according to its clinical basis [3]. Although imaging modalities may apply for detection of pelvic wall and parametrium invasion, they do not change the clinical staging [4]. Advancing age of women desiring childbirth is a challenge for the clinician since cervical cancer even in early stage requires radical hysterectomy and chemotherapy resulting in sterility [5, 6]. To overcome this problem fertility-preserving surgery, which is radical trachelectomy, was implemented. In radical trachelectomy, uterine cervix is fully removed whereas the uterine body remains intact allowing pregnancy [7]. Since cervical cancer is locally aggressive and has a 30% mortality rate [2], patients must be chosen adequately. Preoperative evaluations should include the level of tumor extension towards external os, the prediction of tumor size, and tumoral stromal invasion to plan the appropriate treatment [8]. A recent review by Lee *et al.* demonstrated great superiority of magnetic resonance imaging (MRI) in terms of tumor size, endocervical margin distance, parametrial involvement, lower third of vagina involvement, and pelvic sidewall involvement assessments, compared to pelvic examination and optical imaging (e.g.

colposcopy, cystoscopy, or proctoscopy), with biopsy [9].

In this study, the authors aimed to compare preoperative MRI examinations of early-stage cervical cancer patients with their postoperative histopathologic results.

Materials and Methods

This is a retrospective study of 30 women who were diagnosed, operated, and had preoperative MRI examinations in the present institution between July 2006 and August 2011. Ethical approval of the study was obtained from the Institutional Ethics Committee. Medical charts of the patients were examined. Demographic data (age, parity, menopausal status, and duration of menopause), clinical FIGO staging of tumors, MRI examination results, and postoperative pathologic results were recorded.

MRI was performed with a 1.5T scanner and eight-channel body coil was used. Axial T1 FSE, axial and sagittal T2 FSE, axial T1 LAVA fat sat and axial DWI with b values of 50 mm²/s were performed for pelvic examination. Coronal 2D FIESTA, coronal T2 SSFSE, axial T2 SSFSE, axial T1 LAVA (3D) fat sat were performed for abdominal examination. At 18–20 seconds following intravenous injection of gadobenate dimeglumine (Gd-DTPA, 0.1 mmol/kg of body weight) a T1 LAVA fat sat sequence was performed in the abdomen. Pelvic post-contrast imaging was acquired five minutes after intravenous injection with axial and sagittal T1 LAVA (3D) fat sat images.

MRIs were analyzed for presence of cervical tumor, tumor stage, tumor size in 3D (lateral, anteroposterior, and craniocaudal dimension), measured pre- and post-contrast (the longest dimen-

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sion was taken into consideration), invasion depth within cervix (extension distance of tumor from cervical canal to cervical stroma), the presence of parametrial and vaginal infiltration, lymph node involvement, and vesical and rectal invasion by two radiologists experienced in gynecological oncology imaging. The readers were blinded to the clinical data and histopathological results, but they were aware that each patient had at least one cervical cancer. The T2-weighted images and the contrast-enhanced T1-weighted images were separately reviewed with the consensus of two readers.

All patients had undergone radical hysterectomy, bilateral salpingo-oophorectomy, and pelvic and para-aortic lymph node dissections. FIGO re-staging were applied to the patients according to the histopathologic results. The correlation of preoperative clinical FIGO and MRI stagings with postoperative histological staging, preoperative MRI examination accordances with pathological results, and preoperative-postoperative histopathologic consistencies were evaluated.

Statistical analysis were performed by SPSS 19 with a significance level of $p < 0.05$. True positive, false-positive, true-negative, and false-negative findings were assessed for all correlations between MRI and histopathologic findings. The specificity, sensitivity, and positive and negative predictive values were also examined.

Results

The authors studied 30 patients aging between 28 to 72 (49.17 ± 21.17) years, and their mean parity was two. Regarding menopausal status, 16 patients were postmenopausal and 14 patients were premenopausal. There were seven smokers and 23 non-smoker patients. Of the 30 patients, one was asymptomatic, 26 had vaginal bleeding, and 22 had pelvic pain complaint.

When clinical and MRI stagings were compared with pathologic staging, it was seen that clinical staging confirmed one Stage 1a patient out of two and MRI successfully indicated both of them. For Stage 1b1, both clinical and MRI staging correctly introduced six patients out of nine. In Stage 1b2 patients, clinical staging could not de-

Table 1. — Correct staging of MRI and clinical evaluation according to pathological staging.

	Pathological staging (n)	Clinically correct staging (n)	Correct staging by MRI (n)
1a	2	1	2
1b1	9	6	6
1b2	3	0	1
2a	5	0	4
2b	11	0	7
TOTAL	30	7	20

termine any of the patients at this stage, where MRI staging determined one patient out of three. Five patients were at Stage 2a and MRI revealed four of them, despite clinical staging which could not identify any. For Stage 2b, clinical staging could not identify any patients out of 11 where MRI staging revealed seven of them correctly. Consequently in overall analysis, seven patients out of 30 were staged correctly by clinical examination and 20 patients were staged correctly with MRI (Tables 1 and 2).

The MRI staging of Stage 1a patients showed a sensitivity of 1, specificity of 0.93, positive predictive value of 0.50, and negative predictive value of 0.92. For Stage 1b1 these values were 0.66, 0.84, 0.33 and 0.87, respectively. For Stage 2b it had a sensitivity of 0.63 and specificity of 0.95. In overall analysis MRI had a sensitivity of 0.66 (Table 3).

In the present study the authors detected 17 patients that had a tumor less than 4 cm. Only eight of these patients' MRI stagings revealed accurate dimensions. MRI also correctly diagnosed nine of 13 patients having a tumor of larger than 4 cm. MRI sensitivity in correct tumor size detection was found as 0.68.

Cervical ring invasion was detected in 20 patients. MRI elected 13 of them positively. Of the ten patients who did not have ring involvement, MRI showed six of them cor-

Table 2. — Comparison of different stagings.

		Pathological FIGO Staging					TOTAL
		1a	1b1	1b2	2a	2b	
Clinically FIGO Staging (n)	1a	1	3	0	0	0	4
	1b1	1	6	3	3	5	18
	1b2	0	0	6	1	0	7
	2a	0	0	0	0	0	0
	2b	0	0	0	1	0	1
MRI FIGO Staging (n)	1a	2	2	0	0	0	4
	1b1	0	6	1	0	2	9
	1b2	0	0	1	0	1	2
	2a	0	1	1	4	1	7
	2b	0	0	0	1	7	8
TOTAL		2	9	3	5	11	30

FIGO: Federation of International Gynecologic Oncology.

Table 3. — Staging accuracy of MRI.

MRI Stages	Sensitivity	Specificity	PPV	NPV
1a	1	0.93	0.50	0.92
1b1	0.66	0.84	0.33	0.87
1b2	0.33	0.96	0.50	0.93
2a	0.96	0.89	0.57	0.95
2b	0.63	0.95	0.87	0.85

PPV: positive predictive value, NPV: negative predictive value.

rectly. The MRI sensitivity of cervical ring invasion was found as 0.65. In this study pathologic evaluation revealed 11 patients with parametrial involvement. MRI was successful in determining seven of these patients. The MRI sensitivity of parametrial invasion was found as 0.63. Pelvic lymph node metastasis sensitivity was 0.33 for MRI. The authors did not detect any para-aortic lymph node metastasis in this study group (Table 4).

Discussion

Despite screening programs and early detection efforts in cervical cancer, it still has high morbidity and mortality rates especially in young women. The International Federation of Gynecology and Obstetrics (FIGO) describes cervical cancer staging clinically [10]. However, recent guidelines encourage the use of imaging modalities such as chest radiography, CT and, MRI as indicated [11]. Recent studies evaluated staging accuracy of MRI and the extent of cancer with respect to fertility-preserving surgery [8, 12-15].

In the present study, MRI staged 20 out of 30 patients correctly (66.6%). Overall accuracy of MRI staging varies between 76% to 79 % in the literature which is higher than the present results [12, 16, 17]. This might be because of the fact that these studies are not specific to early stages of cervical cancer, they even include inoperably high-stage patients. Another reason might be the small sample size and unequal distribution of early stage patients. Because in the present study 20 of 30 patients were in Stage 1b1 and 2b

and we know that parametrial invasion detection by MRI can vary according to consistences of different tissues as fat, vascular structures, and ligaments [17].

Only seven patients (23.3%) were staged correctly with clinical examination. This finding is well-correlated with literature indicating that MRI staging is superior to clinical examination in early stages of cervical cancer. Ozsarlak *et al.* found clinical staging accuracy (47%) lower than MRI in a study with 29 patients [18]. One of the highest accuracy rates of clinical staging in literature is 61.3% from a study by Dhoot *et al.* [19]. Because in this study 66% of all cases were in inoperable high stages, whereas the highest stage in the present study group was Stage 2b.

In the present study, MRI overstaged 10% and understaged 23% of the cases. In a study by Choi *et al.* MRI overstaged 11% and understaged 12% of their study group. Although their overstaging rate is similar with the present study, the authors had a higher rate of understaging [16]. However in their study, the majority of the patients were grouped as “Stage 1b and lower” without any subgroup specification. In the present study more than half of the patients were either Stage 2a or 2b and MRI sensitivities of Stage 2a and 2b were 0.96 and 0.95, respectively. This shows that both studies had similar understaging rates if Stages 2a and 2b are compared. A review including 12 studies, evaluated cervical cancer staging accuracy of MRI, revealed 14% as overstaged (range 2-53%) and 8% as understaged (range 0-17%) [17]. However there were some technical differences between the included studies. In some of these studies some patients had had radiotherapy before surgery leading to misapprehension of MRI overstaging. In the present study none of the patients received radiotherapy before surgery. Besides in these studies, 0.15 to 2T MRI examinations were used which may have led to divergent image quality. The present authors implemented 1.5 T MRI for every patient.

MRI is the best method in staging cervical cancer with its high soft tissue resolution. Parametrial invasion is one of the most important prognostic factors for cervix cancer which affects treatment modality. Integrity of low signal intensity of stromal ring surrounding cervical cancer in

Table 4. — MRI and pathology findings of tumor invasion.

Tumoral characteristics	MRI				Pathology	
	Only present on MRI	Present in MRI and Pathology	Only not-present on MRI	Not present both on MRI and pathology	Present	Absent
Cervical ring invasion (n)	17	13	13	6	20	10
Parametrium invasion (n)	8	7	22	18	11	19
Pelvic lymph node invasion (n)	3	3	27	21	9	21
Paraaortic lymph node invasion (n)	0	0	0	30	0	30

cervix on T2A weighted MR images, have high predictive accuracy and negative predictive rate in determining negative parametrial invasion [20]. In the present study MRI revealed 13 of 20 patients with cervical ring involvement and four patients were misdiagnosed as positive by MRI (sensitivity: 65%, specificity: 60%, negative predictive value: 46%). For parametrial invasion, MRI had a sensitivity of 63% and negative predictive value of 64%, which supports the stromal ring-parametrial invasion association defined in literature.

In the present study MRI had a sensitivity of 33.3% and a specificity of 100% in the analysis of pelvic lymph node metastasis, which is concordant with literature [16]. The present authors did not detect any para-aortic lymph node metastasis either in MRI or pathologic diagnosis because all the patients were in the early stages of cervical cancer.

The limitation of this study include small sample size and unequal patient number distribution of cancer stages. However, all patients were in the early stages of cervical cancer which is a strength of this present study.

Conclusion

MRI staging is superior to clinical staging even in early stages of cervical cancer. In preoperative preparation, MRI should be considered as a useful tool especially in patients who desire fertility preserving surgery.

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