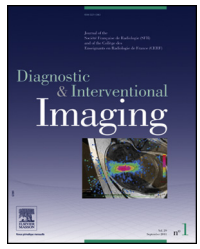
Diagnostic and Interventional Imaging (2016) **97**, 177—186



ORIGINAL ARTICLE /*Genito-urinary imaging*

Efficacy of diffusion-weighted magnetic resonance imaging in the diagnosis and staging of endometrial tumors☆

I.S. Kececi[a,*], **M.S. Nural**[b], **K. Aslan**[b], **M. Danacı**[b], **M. Kefeli**[c], **M. Tosun**[d]

[a] *Department of Radiology, Samsun Training & Research Hospital, Samsun, Turkey*
[b] *Department of Radiology, Faculty of Medicine, Ondokuz Mayis University, Samsun, Turkey*
[c] *Department of Pathology, Faculty of Medicine, Ondokuz Mayis University, Samsun, Turkey*
[d] *Department of Obstetrics and Gynecology, Faculty of Medicine, Ondokuz Mayis University, Samsun, Turkey*

KEYWORDS
MR imaging;
MR-diffusion weighted imaging;
Endometrial carcinoma

Abstract
Purpose: The goal of this study was to evaluate the efficacy of diffusion-weighted imaging (DWI) in differentiating between benign and malignant endometrial lesions and determinining tumor grade. It also aimed to determine the contribution of the DWI to the diagnosis by detection of the myometrial invasion depth in malignant lesions.
Materials and methods: The lesions were classified as benign ($n = 14$) or malignant ($n = 42$) according to the histopathological results and, the mean apparent diffusion coefficent (ADC) values were compared. For determining the myometrial invasion depth of malignant lesions, T2W, DWI and dynamic contrast-enhanced T1-weighted images (DCET1WI) were evaluated individually.
Results: The sensitivity, specificity and area under the curve for discriminating between malignant and benign lesions by using cutoff ADC value of 1.10×10^{-3} s/mm^2 were 85.7%, 92.8% and 0.95, respectively. According to the histopathological grading, there was no difference for the mean ADC values. For both observers the diagnostic accuracy of MRI in determining the depth of myometrial invasion in malignant lesions was found to be 87.1%, 89.7% and 76.9%, 76.9% for T2WI-DWI and DCET1WI, respectively.

☆ This study has been supported by Project Management Office of Ondokuz Mayis University (Project No.: PYO.TIP.1904.10.007).
* Corresponding author at: Department of Radiology, Samsun Training & Research Hospital, Yesildere mah. Akca cad. Mimoza S., 55200 Samsun, Turkey.
E-mail address: drilsen@hotmail.com (I.S. Kececi).

http://dx.doi.org/10.1016/j.diii.2015.06.013

Conclusion: DWI and ADC measurements can accurately discriminate endometrial cavity lesions as benign or malignant. T2WI-DWI is highly effective in determining the depth of myometrial invasion.

In endometrial cancer, the disease stage, the depth of myometrial invasion of the tumor, and the histological grade are important factors, which determine prognosis and treatment. Histological grade is associated with the degree of differentiation of the tumor. As well as myometrial invasion, pelvic and para-aortic lymph node metastasis, tumor grade is directly associated with adnexal metastasis, positive peritoneal cytology, local recurrence and hematogenous spread [1]. In the high-grade tumors with deep myometrial invasion, in addition to total abdominal hysterectomy and bilateral salpingo-oophorectomy, lymph node dissection is performed and, in some patients, preoperative radiotherapy is applied [2]. These prognostic factors should be evaluated in the preoperative period in order to determine the appropriate treatment protocol.

Magnetic resonance imaging (MRI) is an ideal imaging modality for pelvic examination and known as the most accurate modality for the evaluation of endometrial pathology in the pretreatment period. Due to the fact that the signal intensity of a small tumor in MRI may resemble that of a normal endometrium rather than a endometrial tumor, the accuracy of imaging of the tumor may be constrained. A focal mass in T2-weighted (T2W) images may appear similar to the submucosal degenerated leiomyoma, adenomatous hyperplasia and hemorrhage within the cavity. The contrast between tumor and normal endometrium is pronounced with administration of Gadolinium-DTPA and it becomes possible to distinguish the small tumors [3]. However, due to concomitant myomas, in cases where the endometrial cavity is depressed or in the presence of adenomyosis, diagnostic difficulties may arise. Again, in patients with contrast agent allergy or impaired renal function, imaging methods, which can be an alternative to examination with contrast material, are needed.

Diffusion-weighted imaging (DWI) is becoming a part of the standard imaging protocols for the assessment of the female pelvic region, in recent years [4]. The image contrasts in DWI are a result of changes in the diffusion of water molecules in tissues. Malignant tumors are composed of tumor cells which are randomly organized and created an intense group. This effect prevents the free movement of water molecules, causing diffusion limitation. In the studies performed in recent years, it has been shown that the apparent diffusion coefficent (ADC) value in malignant lesions detected in the endometrial cavity were significantly lower than in benign lesions and normal tissue [5,6]. In different studies, it has been reported that DWI can replace dynamic contrast-enhanced T1-weighted (DCET1W) images in the assessment of myometrial invasion and can be used with T2W images in routine [7,8].

The study aimed to evaluate the efficacy of DWI in the differentiation of benign and malignant lesions of the endometrial cavity and the determination of tumor grade. It also aimed to determine the contribution of the DWI to the diagnosis by detection of the myometrial invasion depth in malignant lesions.

Materials and methods

Patients

The study group was created with patients with prediagnosis of endometrial pathology at the department of obstetrics and gynecology, between June 2010 and August 2011 and whose gynecologic pelvic MRI indicated the need for gynecological evaluation. The patients on whom dilatation and curettage (D & C) was performed before MRI and therefore whose cavities was filled with hemorrhagic content were excluded from the study. The patients with permanent ferromagnetic prosthesis implantation and those who displayed sensitivity to the paramagnetic contrast agents which were reported due to MRI examinations made previously were excluded from the study group. This prospective study was approved by the hospital ethics committee. Informed consent was obtained from all subjects included in the study.

A total of 56 patients between the ages of 35—86 (mean 56.0 ± 12.8 years) who were subjected to MRI with the prediagnosis of endometrial pathology and had lesions detected within the endometrial cavity were included in the study. The final diagnoses of the patients were based on the histopathological results of the materials obtained after surgery and/or D & C.

Technique

All MR examinations were performed on a 1.5-tesla (Siemens Magnetom Symphony Quantum, Erlangen, Germany) MRI device with a six-channel phased-array coil. Lower abdominal MR imaging protocols were created with the following sequences: the coronal True-FISP (TR/TE: 4.30 ms/2.15 ms, slice thickness: 5 mm, field of view [FOV]: 450 mm, matrix 256×90, flip angle [FA]: 780, number of signal averages [NEX]: 1), and axial and sagittal T2W TSE sequence was obtained (TR/TE: 4970 ms/97 ms, slice thickness: 3 mm, FOV: 280 mm, matrix 256×60, FA: 1500, NEX: 4). Before contrast administration, T1W flash 2D axial sequence (TR/TE: 173 ms/2.35 ms, slice thickness: 5 mm, FOV: 500 mm, matrix 256×70, FA: 700, NEX: 1) after contrast administration, T1W flash 3D axial [T1W flash 3D VIBE]