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Original Article

Efficiency of diffusion weighted magnetic resonance in differentiation between benign and malignant endometrial lesions

Ahmed Elsammak, S.M Shehata *, Mona Abulezz, Ghada Gouhar

Diagnostic Radiology Department, Zagazig University, Egypt

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ABSTRACT

Objectives: To assess the role of DW-MRI and ADC values in distinguishing benign from malignant endometrial disorders.
Patients and methods: Pelvic ultrasound, conventional MRI, DW-MRI and histopathologic examinations were done for 42 female patients with abnormal vaginal bleeding. Mean ADC values of endometrial lesions were calculated and compared.
Results: Endometrial malignancies showed significant low ADC values ($0.82 + 1.09 \times 10^{-3}$ mm^2/s) compared to benign lesions ($1.44 + 0.15 \times 10^{-3}$ mm^2/s) (p: 0.000). Using 1.19×10^{-3} mm^2/s as cut-off value for distinguishing malignant from benign lesions achieved 88.9% sensitivity and 100% specificity.
Conclusion: DW-MRI is useful in distinguishing malignant from benign endometrial lesions and tumor staging as well.

1. Introduction

The endometrial cavity abnormalities represent a significant diagnostic challenge for radiologists. This may be attributed to the potentially overlapping imaging features of the normal endometrium influenced by the phase of menarche in addition to variable benign and malignant endometrial lesions including submucosal fibroid, endometrial polyp, endometrial hyperplasia, and endometrial neoplasms [1–4].

Endometrial cytology can diagnose some endometrial lesions [2]. Sonographic findings of endometrial thickening, heterogeneity and a focal endometrial lesion are non-specific with possible interfere between malignant and benign disorders [5,6].

Magnetic resonance imaging plays an important role in evaluation of suspected endometrial pathology. DCE-MRI is considered an accurate tool for detection of invasion of the myometrium and cervix in cases of endometrial malignancies with some limitations concerning lesion depiction [7].

Using DW-MR imaging and the ADC value can be helpful in differentiation of benign from malignant pelvic lesions [8,9]. Generally, dense packed tissues with high cellularity such as cancers have a relatively little extracellular space thus leads to restricted water motion and hence having lower ADC values compared to the benign lesions as well as normal tissues [10–12].

The aim of this study is to evaluate the value of Diffusion-weighted MRI in assessment and distinguishing benign from malignant endometrial lesions using the histopathologic results as a gold standard.

2. Patients and methods

2.1. Patients

The study included 42 Female patients. The examined cases age was ranged from 18 to 79 years old. They were referred from the Obstetrics and Gynecology department to Radiodiagnosis department during the period from February 2015 to February 2016 after obtaining a local institutional board review (IRB) approval and informed consent from all patients before the study.

Inclusion criteria were patients with abnormal vaginal bleeding or abnormal thickened endometrium that was proven ultrasonography. Exclusion criteria included patient on hormonal therapy, patients with systemic causes of bleeding and patients with absolute contraindication to MRI (patients with cardiac peacemakers or

Abbreviations: DW-MRI, diffusion-weighted MRI; ADC, apparent diffusion coefficient; PPV, positive predictive value; NPV, negative predictive value; FIGO, International Federation of Gynecology and Obstetrics.

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* Corresponding author.
E-mail addresses: aelsammak@gmail.com (A. Elsammak), samarshehata2003@gmail.com (S.M Shehata), dr_moh_hesham20@hotmail.com (M. Abulezz), ghadagouhar@yahoo.com (G. Gouhar).

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metallic prosthesis). MRI examination was done for all cases after thorough history taking (regarding course of the disease, duration, menstrual history and parity) and pelvic or Trans-vaginal Ultrasound examination of the pelvis performed at ultrasound system of (Seimens Acuson X300).

2.2. Imaging protocol

There is no certain MRI protocol that is considered worldwide accepted for gynecological tumors [7].

All magnetic resonance examinations were done using a 1.5-Tesla super conducting magnet (Achieva, Philips Medical System, Best, the Netherlands) with a standard pelvic surface coil. All patients underwent Conventional MRI followed by DW-MRI and finally Conventional MR imaging with contrast administration. The patients were examined in supine position with head first and were asked not to move during examination. The MR protocol in our institution is as follows;

- Localizer images in both axial and sagittal planes.
- Fast spin echo (FSE) T1-weighted images (TR 497 ms, TE 12 ms, matrix 320 × 512, slice-thickness: 4–5 mm with an inter-slice gap of 1–2 mm, FOV 250 mm and a flip angle of 90) in axial and sagittal plane.
- Fast spin echo (FSE) T2-weighted images (TR 3.3 s, TE 90 ms, matrix 256 × 512, slice-thickness: 4–5 mm with an inter-slice gap of 1–2 mm, FOV 250 mm a flip angle of 90) in axial and sagittal plane.
- Diffusion weighted magnetic resonance imaging: using a Single Shot spin echo planar sequence with free breathing; the following parameters were used (TR 2.8 s, TE 72, matrix 512 × 512, slice-thickness 4 mm with an inter-slice gap of 1 mm and FOV 300 mm) were acquired on axial and sagittal planes. The diffusion sensitizing gradients were applied using a b factor of: 0, 800 and 1000 s/mm^2 in each patient. ADC maps were automatically generated for all DW images and ADC values were measured at b-value: 1000 s/mm^2.
- Conventional MR imaging with GD-DPTA with dose 0.1–0.2 mmol/kg BW). Contrast enhanced axial T1 spin echo with fat suppression was performed after DW imaging utilizing the following parameters TR 621 ms, TE 18 ms, matrix 205 × 512, and slice-thickness: 4-5 mm with an inter-slice gap of 1–2 mm, FOV 280 mm and a flip angle of 90).

2.2.1. Image analysis

All images were reviewed by the radiologists on two separate sessions and were analyzed for signal intensity and homogeneity on T1WI and T2WI compared to the adjacent normal myometrium. Myometrium invasion was diagnosed when the low signal intensity band of the junction zone is disrupted by lesions on T2-weighted images; also assessment of enhancement pattern on post contrast images is essential for diagnosis.

The isotropic diffusion images with b value = 1000 s/mm^2 were assessed in axial plane, and ADC maps were generated automatically. Diffusion weighted images were reviewed with the conventional MR images for better anatomic localization of the endometrial lesion, then the largest ROI was placed within the lesion avoiding the areas of fluid or necrosis within the uterine cavity as well as adjacent normal myometrium and endometrium. Finally we measured the ADC value of each lesion.

2.3. Histopathologic correlation

Final diagnosis for all endometrial lesions was made by correlation between magnetic resonance including diffusion readings and histopathologic sections which were performed in all cases either after dilatation and curettage or after hysterectomy.

2.4. Statistical analysis

According to the histopathologic analysis of the endometrial lesions, we divided our patients into benign group and malignant group. Data obtained by MRI and histopathology were collected and compared. We used SPSS, Version 15.0.1, Inc., Chicago IL for Statistical analyses. We calculated the mean ADC value of both groups. To compare the results between benign and malignant groups we used Student's *t*-test; while we used ANOVA test to compare the elements of each group; considering significance when P value was less than 0.05.

Finally the ADC cut-off value for differentiating between benign lesions and malignant endometrial masses was determined using Kappa test. Diagnostic accuracy of DW- MRI was assessed regarding the sensitivity, specificity, positive and negative predictive values.

3. Results

Our study included 42 female patients presented with post-menopausal vaginal bleeding (48%), pre-menopausal bleeding (38%) or pelvic pain (14%). Those aged between nineteen and seventy-six years (mean age: 59.1 + 7.5). The most common age group was 60–70 years (33.2%) followed by 50–60 years (23.8%).

Patients were classified into benign (24 cases; 57%) and malignant (18 cases; 42%) groups according to their histopathologic results. the most common benign lesion was endometrial hyperplasia (14/24) while the most common malignant lesion was endometrial carcinoma (16/18). The final clinical diagnoses were the following: Endometrial hyperplasia (n = 14; 33.3%), Endometrial polyp (n = 4; 9.5%), Submucosal fibroid (n = 6; 14.3%), Endometrial carcinoma (n = 16; 38.1%) and Choriocarcinoma (n = 2; 4.7%).

The trans-vaginal appearance of different endometrial lesions was uniform in 8 patients with endometrial hyperplasia (19%), 4 patients with endometrial polyp (9%), 2 patients with endometrial carcinoma (4.7%) while it was non uniform in 6 patients with endometrial hyperplasia (14. 2%), 14 patients with endometrial carcinoma (33%), 6 patients with submucosal fibroid (14.3%) and 2 cases of choriocarcinoma (4.7%).

Comparing the endometrial thickness of benign and malignant lesions measured by trans-vaginal ultrasound revealed a significant statistical difference with lower values observed in cases of benign endometrial lesions. The Mean endometrial thickness was: (12 mm ± 1.8) in endometrial hyperplasia, (9 mm + 1.4) in endometrial polyp compared to (20 mm ± 3.2) in endometrial carcinoma (Fig. 1).

Comparing the signal intensity and enhancement pattern between both groups revealed that most malignant lesions showed hypointense signals at T1WI, heterogeneous signals at T2WI and heterogeneous enhancement while most benign lesions displayed hypointense signals on T1W images, hyperintense signals on T2W images and were faintly enhanced (Table 1).

In the current study Conventional MRI could correctly diagnose 36 cases out of 42 cases. It correctly diagnosed 22/24 benign lesions and 14/18 malignant lesions, achieving (77.8%) Sensitivity, (991.7%) Specificity, (87.5) PPV and (84.6%) NPV with (p value = 0.00).

Analysis of the signal intensities on DW images of the studied endometrial lesions revealed that all endometrial malignancies displayed high signal intensities at DWI (b = 1000 s/mm^2) and low signal intensities at ADC map, while 18 cases with benign