



Diffusion-weighted imaging in the evaluation of hormonal cyclic changes in abdominal wall endometriomas



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AIM: To investigate the utility of diffusion-weighted (DW) magnetic resonance imaging (MRI) in the diagnosis of abdominal wall endometrioma (AWE) and to compare the ADC (apparent diffusion coefficient) values of AWE with those of the uterine endometrium during two different phases of the menstrual cycle.

MATERIALS AND METHODS: A total of 22 women aged between 27 and 42 years (mean 32.8 years) and who had regular menstrual cycles were included in the study. These patients had a total of 25 AWE lesions. The mean and standard deviation of the ADC values of the normal endometrium/AWE were calculated for the menstrual and luteal phases. All examinations were performed using a 1.5 T magnet (b-values of 50, 400, and 800 mm/s²). The results were analysed using the Shapiro–Wilk test, the Pearson correlation test, the analysis of variance (ANOVA) test, and the paired sample *t*-test.

RESULTS: The ADC values of the endometrium were different in the two phases of the menstrual cycle (menstrual phase: 0.924 ± 0.171; luteal phase: 1.171 ± 0.135). Similarly, the ADC values of the AWE were different in these phases (menstrual phase: 0.937 ± 0.256, luteal phase: 1.256 ± 0.215). In both AWE and the uterine endometrium, the ADC measurements were significantly lower in the menstrual phase than during the luteal phase. This difference was statistically significant (*p* < 0.05). There was no significant difference in the ADC values between the endometrial layer and AWE during the same phase (*p* = 0.216 for menstrual phase, *p* = 0.104 for luteal phase, paired sample *t*-test).

CONCLUSION: The present study demonstrated that in all patients, the DWI features of AWEs were significantly similar to those of the uterine endometrial tissue. Additionally, the ADC measurements of the patients showed similar cyclical changes. These results suggest that the ADC values of a lesion close to the uterine endometrium may be used to differentiate AWE from the other disease entities of the abdominal wall.

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Introduction

Endometriosis is classically defined as the presence of functional endometrial glands and stroma outside the uterine cavity [1,2]. The extrapelvic implantation of

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endometrial tissue has been described in virtually every organ [3]. The abdominal wall is an uncommon site of extrapelvic endometriosis, where it usually develops in an old surgical scar. At caesarean section, the reported incidence of endometriosis is 0.03–1.7% [4,5], but its true incidence could be higher. Its diagnosis can be difficult and is usually only reached after exploration and tissue analysis.

The radiological features of abdominal wall endometrioma (AWE) are non-specific. Therefore, its diagnosis using ultrasonographic and computed tomographic methods is very difficult. However, magnetic resonance imaging (MRI) provides detailed information about AWE, especially for preoperative surgical planning, by virtue of its multi-planar property and excellent soft-tissue resolution. The endometrium of premenopausal women shows variations in width and in T1 and T2 signal intensity characteristics during various phases of the menstrual cycle. As such, AWE should show similar cyclic changes because it has a similar cellular structure to the endometrial lining. The present study describes the comparison of MRI, including diffusion-weighted imaging (DWI) and apparent diffusion coefficient (ADC) measurements, of abdominal wall lesions and the uterine endometrial layer in 22 patients with AWE. The MRI examinations were performed during two different phases of the cycle. Currently, to the authors' knowledge, only a few reports on DWI MRI in AWE have been published [8–10]. This is one of the first reports on the ADC changes in the normal uterine endometrium and in AWE during two different phases of the menstrual cycle. The aim of the present study was to investigate the usefulness of DWI-MRI in the diagnosis of AWEs.

Materials and methods

Patients

This prospective study was approved by the Institute Ethics Committee, and written informed consent was obtained from all patients. Between March 2009 and March 2012, 22 women with 25 abdominal wall masses and with a high index of suspicion of AWE were examined using pelvic MRI at two centres, Şifa University Faculty of Medicine and Atatürk University Faculty of Medicine. The 22 patients had a mean age of 32.8 years (range 27–42 years; SD 5.62). Patients who had menstrual irregularities, a pacemaker, metallic implants in the central nervous system, or claustrophobia, and patients taking oral contraceptives or hormonal therapy, were excluded from the study. The presenting symptoms were abdominal wall masses ($n = 8$), cyclic ($n = 21$) or non-cyclic pain ($n = 11$), and dysmenorrhea ($n = 5$). Three patients considered to have congenital endometriosis had no history of operation, and they had a mass around the umbilicus with cyclic pain. All other patients had a history of prior gynaecological operations as follows: caesarean sections in 13 patients, laparoscopic cystectomy in three patients, diagnostic laparoscopy in two patients, and a laparotomy for a ruptured right ovarian cyst in one patient. The mean interval between the gynaecological operation to the presentation with a mass was 2.7

years (range 6 months to 11 years). In all patients, ultrasonography (USG) examination prior to MRI revealed a hypervascular mass lesion that was suspicious for AWE. Luteal phase MRI was performed with the routine pelvic MRI protocol for diagnostic work-up, and a menstrual period MRI was performed for the research protocol. All patients who met the inclusion criteria underwent two MRI examinations, one during the first or second day of the menstrual period, when the menorrhagia was most intense, and another one during the luteal phase of the cycle, from the 15th day to menstruation.

MRI technique

MRI, including conventional and DWI in three orthogonal directions with three b-values (50, 400, and 800 mm²/s²), was performed with a 1.5 T MRI unit (Avanto or Espree, Siemens, Erlangen, Germany). All patients were examined in the supine position using an eight-channel phased-array body coil. The examinations were performed during the luteal phase of the menstrual period and during the first 2 days of the cycle when the menorrhagia was the most intense. The parameters and sequences used for the pelvic MRI were as follows: fast spin-echo T2-weighted axial and coronal images [4060–10,000 ms repetition time (TR), 17–182 ms echo time (TE)] and T1-weighted axial images (607– ms TR, 4–13 ms TE), and fat-saturated T1 (536 ms TR, 13 ms TE) and T2 (5270–10,000 ms TR, 17–182 ms TE) images with a matrix of 248 × 256, a section thickness of 6 mm, an interval of 40 mm, and a field of view (FOV) of 350–400 mm. In the luteal phase examinations, the whole pelvis was scanned and contrast-enhanced T1-weighted axial and sagittal images with fat saturation were obtained after a 0.1-mmol/kg intravenous injection of gadolinium diethylenetriamine pentaacetic acid (Magnevist, Schering, Berlin, Germany). No contrast medium was used in the menstrual day examination. DWI was performed for all patients in both studies using a single-shot echo-planer imaging (EPI) sequence (4100 ms TR, 82 ms TE) with an FOV of 350 cm, a matrix of 192 × 192, a section thickness of 4 mm, an intersection gap of 0 mm, and b-values of 50, 400, and 800 mm². The diagnostic quality of the DWI-MRI images was good in all cases, and no cases were excluded from the study. A surface localizer made of fish oil capsules was used to detect the exact level of the lesions.

Image analysis

All images were reviewed on a picture archiving and communication system workstation monitor (PACS with Leonardo console software version 19A and the Syngo console; Siemens, Erlangen, Germany) by three radiologists (B.G., A.S., and M.K.), who each had at least 7 years of clinical experience interpreting MRI images of the body. The final diagnosis was made in consensus. The suspicion of AWE was raised because of pain symptoms related to the menstrual period and a location in or close to a scar. The radiologists evaluated the lesions with respect to their location, signal intensity, and contrast enhancement

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