The Egyptian Journal of Radiology and Nuclear Medicine (2014) **45**, 975–985

Egyptian Society of Radiology and Nuclear Medicine

The Egyptian Journal of Radiology and Nuclear Medicine

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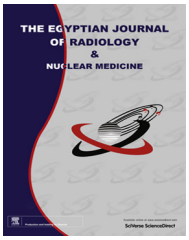

ORIGINAL ARTICLE

Dynamic contrast enhanced MRI in correlation with diffusion weighted (DWI) MR for characterization of ovarian masses

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Received 3 February 2014; accepted 2 April 2014
Available online 10 May 2014

KEYWORDS

Diffusion weighted;
Magnetic resonance imaging;
Dynamic;
Ovarian tumor

Abstract *Introduction:* Ovarian tumors; are the second most common gynecological tumor and are the fifth commonest tumor in women. It is desirable to preoperatively differentiate benign from malignant tumor to decide whether surgery is required, and which type of surgery is appropriate avoiding unnecessary surgery, adding dynamic contrast and diffusion weighted to conventional images can help in differentiation of benign ovarian tumor from malignant. DWI depends on the fact that water molecules can diffuse freely in low cellular environment, while tissue hyper cellularity causes its restriction. As a result, malignant ovarian tumors due to its hypercellular nature show restriction of diffusion, unlike most benign tumors. This study aims at reviewing and emphasizing the role of dynamic contrast enhanced MRI and diffusion-weighted MR in characterization of ovarian lesions.

Patients and methods: This study was performed on 30 patients referred to the radiology department from surgical department by ovarian masses. Pelvic MR with DWI was done for all patients, DCE-MR was done for 29 out of 30 patients. Twenty-five patients underwent surgery with pathologic correlation. Five patients were put under regular follow up US for 3 months.

Results: The sensitivity of MRI was 99.9% while that of DWI was 100%. The specificity was higher for DWI (75%) compared to conventional MRI (58.3%), as well as the accuracy which was 73.9% for MRI while that of DWI was 86.9%. The mean ADC values for malignant lesions were ($0.84 \times 10^{-3} \pm 0.1$ SD mm^2/s), while that for benign lesions were ($1.8 \times 10^{-3} \pm 0.5$ SD mm^2/s), with cut off 1.2×10^{-3} and p value = 0.005. Mature teratomas showed restricted diffusion with ADC values 0.8×10^{-3} mm^2/s (false positive), due to mixed cellularity of the teratoma.

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Peer review under responsibility of Egyptian Society of Radiology and Nuclear Medicine.

 http://dx.doi.org/10.1016/j.ejrnm.2014.04.002

Hemorrhagic cysts and endometriomas showed high signal not only on diffusion images but also on corresponding ADC map and ADC values 1.3–1.4 × 10^{-3} (T2 Shine-through). Sensitivity of MRI was 99.9% while that of DCE-MRI was 60%. The specificity was higher for DCE 91% compared to conventional MRI sequences 58.3%, as well as the accuracy which was 73.9% for MRI while that of DCE was 77% and so addition of DCE to the MRI is expected to increase the specificity and the accuracy of examination.

Conclusion: Combination of DWI and DCE to conventional MRI improves the specificity of MRI and thus increasing radiologist's confidence in image interpretation which will finally reflect on patients' outcome and prognosis.

1. Introduction

Functional imaging is becoming increasingly important in the evaluation of cancer patient in initial diagnosis and the assessment of response to therapy. Recent technical advances allow the use of dynamic and diffusion MR imaging in abdominal and pelvic applications (16).

DCE-MRI depends on the leakage of contrast agent from capillaries into the extravascular extracellular space, thus allowing quantitative analysis which reflects the blood flow and the vascular permeability (1).

DCE-MRI of ovarian tumors is recommended for accurate characterization of internal architecture, especially for delineation of necrosis, papillary projections, solid components, septations, and peritoneal implants (17).

Recent studies evaluated the use of DCE-MR imaging to further characterize adnexal masses. It provides information on tumor vascularity and perfusion. It also provides more post processing quantitative data (11).

DWI is a non-invasive modality that helps in discrimination between benign and malignant lesions, increases the contrast between lesions and surrounding tissues, and improves the detection and delineation of peritoneal implants at both initial staging and follow-up. Moreover, diffusion-weighted imaging provides quantitative information about tissue cellularity that may be used to distinguish viable tumors from treatment-related changes (7). When diffusion-weighted MR imaging is used in gynecologic applications, cancers have shown lower ADC (apparent diffusion coefficient) values. Increasing ADC values is noted in carcinomas responding to radiation therapy, so it can be used as a biomarker for treatment response, and in the evaluation of recurrence and multi focality (10).

This study aims at reviewing and emphasizing the role of dynamic contrast enhanced MRI and diffusion-weighted MR in characterization of ovarian lesions.

1.1. Patients and methods

This study was performed on 30 patients presented by ovarian masses, referred to the radiology department from surgical department based on U/S study as a prospective study. Pelvic MR with DWI was done for all patients, DCE-MR was done for 29 patients (one case was renal failure). Twenty-five patients underwent surgery with pathologic correlation. Five patients were put under regular follow up US for 3 months.

The study was conducted from November 2012 to June 2013 at the National Cancer Institute and Kasr El-Ainy hospital.

The patient's age ranged from 13 to 70 years.

Fourteen patients presented by vague pelvic pain, 6 were complaining of abdominal swelling, 6 accidentally discovered on regular post-operative follow up, 5 patients (after oophorectomy) for malignant ovarian tumor and one patient (after hemi colectomy) for cancer colon, and 4 patients were complaining of vaginal bleeding and infertility (see Cases 1–4).

All cases had been subjected to the full history taking with a special emphasis on: age, parity menstrual history, past history of gynecological troubles or operations, Pelvi-abdominal U/S TV/US and previous MRI.

1.2. MR imaging

MR imaging was performed on a 1.5-T MR imaging unit (Achieva, Philips medical system). All the patients were imaged in the supine position using pelvic phased-array Torso coil.

1.2.1. Patient preparation

Intravenous administration of an antispasmodic drug (10 mg of visceralgine) was given immediately before MR imaging to reduce bowel peristalsis.

2. MR imaging protocol

- Non contrast.
- Axial T1-weighted (TR/TE, 500/10 ms).
- Axial T2-weighted (TR/TE, 3300/100 ms).
- Slice thickness, 6 mm. Gap, 1 mm. FOV, 32–42 cm. Matrix, 256 × 256.
- Sagittal T2-weighted and Coronal T2-weighted, Slice thickness, 8–10 mm. Gap, 1 mm. FOV, 40–50 cm. Matrix, 256 × 256.
- DW-MRI was acquired in the axial plane prior to administration of contrast medium by using a single shot echo-planar imaging sequence.
- With *b* values (0, 300, 600). TR/TE, 5000/70. Slice thickness, 6 mm. Gap, 1 mm. FOV, and 36 cm. Matrix, 128 × 128.

Dynamic contrast-enhanced MRI: post contrast T1 fat sat THRIVE (High Resolution Isotropic Volume Examination) images were obtained immediately after manually injected