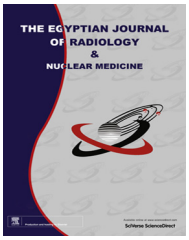
The Egyptian Journal of Radiology and Nuclear Medicine (2015) **46**, 1279–1289

Egyptian Society of Radiology and Nuclear Medicine

The Egyptian Journal of Radiology and Nuclear Medicine

www.elsevier.com/locate/ejrnm
www.sciencedirect.com



ORIGINAL ARTICLE

Diffusion-weighted magnetic resonance imaging in the assessment of ovarian masses with suspicious features: Strengths and challenges

Sahar Mansour *, **Rasha Wessam**, **Mariam Raafat**

Radiology Department (Women's Imaging Unit), Kasr ElAiny Hospital, Cairo University, Egypt

Received 24 February 2015; accepted 30 June 2015
Available online 26 July 2015

KEYWORDS

Diffusion-weighted;
MR imaging;
Ovarian tumors;
ADC value

Abstract *Objective:* To evaluate diagnostic performance of diffusion weighted imaging (DWI) in evaluating ovarian masses with suspicious features on magnetic resonance imaging (MRI).
Patients and methods: Pelvic MRI and DWI assessed 235 complex and solid ovarian masses of suspicious MRI features. On DWI, scanning acquired by *b* values: 0, 500, 1000 and 1500. Analysis considered signal intensity (SI) at *b*1000 and the mean ADC values for the solid components of the masses.
Results: Included masses proved benign in 75(32%), borderline (low potential malignancy) in 55(23.4%) and malignant in 105(44.6%). Restricted diffusion was observed in all of the invasive malignancy (57.1%, $n = 105/184$). Benign and borderline tumors with high DWI SI presented 15.2% and 27.7% respectively ($P < 0.05$). The mean ADC value was $1.2 + 0.34 \times 10^{-3}$ mm^2/s, $1.1 + 0.06 \times 10^{-3}$ mm^2/s, and $0.83 + 0.15 \times 10^{-3}$ mm^2/s for benign, borderline and malignant masses respectively. The ADC values of malignant masses and benign masses with fibrous components showed no significant difference ($P = 0.333$). Significant difference was detected in those with fatty tissue ($P = 0.002$).
Conclusion: DWI supported by conventional MRI data can confirm or exclude malignancy in suspicious ovarian masses. The combined analysis of quantitative and qualitative criteria and knowledge of the sequence pitfalls are required.

1. Introduction

Ovarian masses present a special diagnostic challenge when imaging findings cannot be categorized into benign or malignant pathology (1).

Excessive surgical procedures such as bilateral oophorectomy with or without hysterectomy have sometimes been

* Corresponding author at: Kasr ElAiny Hospital, Cairo University, Egypt. Tel.: +20 1006029047.
E-mail address: sahar_mnsr@yahoo.com (S. Mansour).
Peer review under responsibility of Egyptian Society of Radiology and Nuclear Medicine.

http://dx.doi.org/10.1016/j.ejrnm.2015.06.023

Table 1 MRI sequences used in the study.

Sequence	TR (ms)	TE (ms)	FOV (mm)	Matrix	Slice thickness (mm)
T2 sagittal	3000	90	290 × 290	208 × 205	4
T2 axial	3700	100	288 × 350	292 × 180	5
T1 axial	500	10	260 × 216	263 × 171	5
T1 SPAIR axial	530	8	240 × 240	240 × 190	5
T2 coronal	5000	90	300 × 300	272 × 200	4.5
DWI (*b* 0, 500, 1000 &1500)	5000	77	240 × 240	124 × 100	5
DCE axial (THRIVE)	2.8	9	370 to 400	512 × 192	1.5

Slice gap is one mm and flip angle 90° in all non-contrast sequences. Abbreviations: FOV = field of view; SPAIR = spectral adiabatic inversion recovery; DWI = diffusion-weighted imaging; DCE = dynamic contrast enhanced; THRIVE = time high resolution isotropic volumetric examination.

performed in patients with benign ovarian tumor because the preoperative diagnosis was inaccurate (2).

Preoperative diagnosis of ovarian tumors based on imaging is important as biopsy is not commonly applicable (3). Ultrasonography (US) is the first-line imaging modality for adnexal lesions and is a particularly useful preoperative test for the characterization of noncomplex masses. Magnetic resonance imaging (MRI) may be of great help in identifying malignant lesions before surgery, particularly when US findings are suboptimal or indeterminate (4).

MR imaging displays morphologic characteristics and signal intensity variations on T1- and T2-weighted images for diagnosis of ovarian masses. Features such as papillary projections, mural nodules, thick septa and solid components can be easily distinguished on MR images, yet these criteria cannot reliably distinguish malignant from benign tumors (5).

With recent advances in ultrafast MR imaging techniques, diffusion weighted (DW) imaging is available to assess discriminant cellular characteristics in abdominal and pelvic organs. DWI is sensitive to changes in the microdiffusion of water into

Table 2 Histopathology, signal intensity at T2WI and DWI and measured mean ADC values of included ovarian masses.

Ovarian tumors (n = 235)	T2WI SI		DCE-MR		DWI (b = 1000)	Mean ADC value × 10^{-3}
	Bright	Intermediate	Early	Delayed	Bright SI	
Epithelial tumors						
–Serous						
Borderline cystadenoma (n = 26)	20	6	10/22	12/22	23/26	1.1 ± 0.22
Malignant cystadenocarcinoma (n = 29)	2	27	26/27	1/27	29	0.9 ± 0.22
–Cystadenofibroma						
Benign (n = 6)	–	6	–	3/6	1/6	1 ± 0.18
Borderline (n = 1)	1	–	–	1	–	1.9
–Mucinous						
Borderline cystadenoma (n = 27)	10	17	18/26	8/26	27	1.2 ± 0.21
Malignant cystadenocarcinoma (n = 21)	2	19	21	–	21	0.8 ± 0.18
–Endometrioid carcinoma (n = 6)	–	6	6	–	6	0.8 ± 0.11
–Clear cell carcinoma (n = 7)	–	7	7	–	7	0.75 ± 0.13
–Brenner (n = 12)						
Benign (n = 11)	–	11	–	11	4/11	
Borderline (n = 1)	–	1	–	1	1	1.1 ± 0.30
–Undifferentiated carcinoma (n = 5)	–	5	3/3	–	5	0.7 ± 0.22
Germ cell tumors						
–Teratoma						
Mature with solid components (n = 12)	–	12	–/10	4/10	5/12	1.2 ± 0.18
Struma ovarii (n = 2)	1	1	–	2	1/2	1.4 ± 0.14
Immature (n = 16)	–	16	11	5	16	1.0 ± 0.81
–Dysgerminoma (n = 5)	–	5	3	2	5	0.7 ± 0.14
Sex-cord stromal tumors						
–Granulosa-stromal cell tumor						
Granulosa cell tumor (n = 5)	4	1	4	1	5	0.9 ± 0.2
Fibrothecoma/thecoma (n = 38)	12	26	11	27	12/38	1.3 ± 0.18
Malignant Sertoli-Leydig Cell (n = 4)	1	3	3	1	4	0.7 ± 0.13
Metastatic (Krukenberg tumor – n = 6)	2	4	5	1	6	1.2 ± 0.11
Others						
–Collusion tumor (n = 4)	4	–	–	1/4	3/4	1.5 ± 0.16
–Endometrioma (n = 1)	–	1	1	–	1	0.7
–Squamous cell carcinoma on to of immature teratoma (n = 1)	1	–	–	–	1	0.8
–Granulomatous T.B. (n = 1)	1	–	–	–	1	1

Note – data are reported as number.