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Evaluation of the Role of MRI in Differentiation Between Benign and Malignant Ovarian Tumors

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Abstract

Magnetic Resonance Imaging became a significant method in the examination of women with adnexal masses. There is multiparametric assessment, using conventional sequences, post contrast assessment as well as the Diffusion MRI weighted imaging. Evaluate the relevance of multiparametric MRI modalities in the identification of ovarian masses. A prospective study was conducted at Radiodiagnosis Department; Al-Zahraa University Hospital involved twenty patients with initial undetermined ovarian lesion. All patients were subjected to the full history taking and physical examination, laboratory investigation, ultrasound examination using trans-abdominal, trans-vaginal ultrasound and MR imaging. This study was conducted on 20 female patients ranged from 21 to 53 years old, about 60 % of lesions were mixed solid and cystic in composition, with more than half of them showed bright T2 signal, DWI of for the 20 lesions were tested and showed that ADC value $\leq 0.96 \times 10\text{-}3$ mm2/s is the optimal cut off for differentiating between benign and malignant masses with sensitivity of 100%, specificity of 78.6%. Multiparametric MRI assessment aid and enhance the confidence in assessing or ruling out probable malignancy of adnexal masses

Keywords: MRI, Ovarian Tumors, Multiparametric MRI assessment.

1. Introduction

Ovarian masses are a prevalent discovery in clinical practice and may be discovered by chance or diagnosed in symptomatic individuals. Identification of ovarian lesions is a diagnostic difficulty; it is critical in the preoperative context to determine appropriate treatment operations [1]. MRI became a significant method in the examination of women with adnexal masses, and it can detect most malignant and benign tumors with high sensitivity and validity [2]. Multiparametric MRI assessment including conventional images (T1 and T2 weighted images), Post contrast series and new advancements in MRI techniques, as diffusion weighted imaging (DWI) and apparent diffusion coefficient (ADC), have increased the difference in contrast between the tumor and the surrounding cells, emphasizing the importance and promise of MRI in the woman pelvis. [3].

It is critical to accurately characterize ovarian lesions in order to provide the best possible care to the patient. Conservative and less intensive treatment is preferable for tumors that are most likely benign. When malignancy is suspected, the main objective is to improve ovarian cancer prognosis [4]. Our rational was to evaluate the role of Multiparametric the identification of ovarian tumors.

2. Patients and Methods

A prospective study was conducted at Radio diagnosis Department, Al-Zahraa University Hospital, Faculty of Medicine, for Girls during the period from February 2021 to July 2021. Twenty patients with initial undetermined ovarian lesion enrolled in this study patients age ranged from 21 to 53 years old. The study was approved by the Research Ethics Committee of Faculty of Medicine for Girls, Al-Azhar University. All individuals provided written informed consent.

2.1. Inclusion criteria

Patients with clinical suspicious of pelvic masses, history of previous ovarian tumor, metastatic ovarian masses and sonographically detected ovarian masses have been enrolled in the study.

2.2. Exclusion Criteria

Patients with MRI contraindications were excluded, such as patient with cardiac pacemaker or artificial valve and claustrophobia. All participants were subjected to the full history taking and physical assessment, laboratory investigation, ultrasound examination using trans-abdominal, trans-vaginal ultrasound, and MR imaging.

2.3. MRI Technique

All participants were scanned in the supine position with the use of a pelvic phased-array coil on a Philips enguinea – 1.5 T machine. Injection of Buscopan I.M, 20 minutes prior to the examination to suppress the bowel peristalsis to avoid misreading of MRI. In-plane spatial resolution: ≤0.7 x 0.7 mm field of view (FOV): 320-360 mm, slice thickness: ≤4 mm, multi-sequences were obtained, as T1 in the axial plane, T1 fat saturation in the axial, coronal, and sagittal planes with (TR\TE 500,20 msec) respectively. T2 in the axial, coronal, and sagittal planes with (TR\TE 4000,400 msec) respectively, and DWI were performed, variable (b) values were done (0, 500, 1000 s/mm2) to get ADC values.

2.4. Data Analysis

MR images were evaluated as follows: involvement of one or both ovaries. The signal intensity of tumors on T1 and T2. According to its composition, MR appearance of the tumor, whether cystic, solid or mixed. In cystic lesions, there are septations or not and septal thickness, Cystic benign tumors showed low SI in T1WI and high SI on T2WI, complex benign-looking masses showed high SI on T1WI, which considered either fat or blood. On fat suppressed images low SI was noted with fat while high SI was still noted in blood, and solid tumor showed low SI in T1WI and high SI on T2WI. Malignant criteria included the presence of wall thickness >3mm, solid vegetations more than 1cm, thick septa >3mm and areas of necrosis and breaking down. Signs of tumor spread for staging were enlarged lymph nodes with loss of fatty hilum, ascites, peritoneal and omental deposits. According to DW images were inspected for the presence of persistent high SI with low ADC in correlation to the solid components of the included masses (restricted diffusion) and Lesions with low signal in DWI and high signal in ADC were considered (facilitated diffusion) on (b) values (1000). According to ADC value we generated the ADC maps from the DWI from b values (0,

500 and 1000s/mm^2), then we selected the ROI manually on the largest possible area of the solid and the cystic component of the tumors, which was then automatically calculated on the workstation to get the different ADC values.

2.5. Statistical Analysis

Computer software package SPSS was used in the analysis. For quantitative variables, mean and standard deviation were presented. Frequency and percentages were presented for qualitative variables, Sensitivity, specificity; PPV, NPV and accuracy all were calculated for the basic conventional MRI and for the advanced DWI. All results were compared with histopathological data.

3. Results

This study was conducted on 20 female patients their age ranged from 21 to 53 years. The age of the patients with benign tumors ranged from 21 to 45 years ,whereas the age of those with malignant tumors ranged from 40 to 53 years . Most of lesions were on the right side (45%) (Table 1). The maximum dimension of the lesions ranged from 5 to 15 cm. Twelve cases showed bright, 5 low and 3 intermediate T2 signal (Table 2)**.** The composition of the lesions was twelve (60 %) mixed solid and cystic, 5 (25%) cystic and 3 (15%) solid (Table 2)**.** Twelve cases (60%) showed restricted diffusion (8 malignant and 4 benign) whereas eight cases (40%) showed facilitated diffusion (Table 2). The benign lesions that showed restricted diffusion include (2 cases of mature cystic teratoma, one case of tubo-ovarian abscess, one case of hemorrhagic cyst)**.** Table (3) showed that mean of ADC values of cystic and solid components were 2.41 ± 0.56 and 1.63 ± 0.91, respectively**.** Mean ADC ± SD in benign and malignant cystic lesions 2.52 ± 0.51 and 2.18 ± 0.65 respectively**.** Mean ADC ± SD in benign and malignant solid lesions 2.19 ± 0.79 and 0.82 ± 0.10 respectively**.** There was high significant statistical correlation between the diffusion pattern of benign and malignant masses as well as ADC value of benign and malignant tumors (Table 4). The histopathological results showed that 12 cases were diagnosed as benign lesion and 8 cases were malignant. (Table 5). Good statistical performance of the MRI values to predict the presence of malignant lesions compared to pathology (Table 6).

Table (1): Distribution of the cases according to age and bilaterality.

		Total no. = 20
Age	Mean ± SD	39.77 ± 9.24
	Range	21 – 53
Bilaterally	Right	9 (45 %)
	Left	6 (30 %)
	Bilateral	5 (25 %)

Table (2): Distribution of the cases according to composition, intensity and DWI.

		Total no. = 20
Composition	Solid	3 (15%)
	Cystic	5 (25%)
	Mixed	12 (60%)
T2 Intensity	Bright	12 (60%)
	Low	5 (25%)
	Intermediate	3 (15%)
DWI	Non restricted	8 (40.0%)
	Restricted	12 (60.0%)

Table (3): ADC values in cystic and solid component of all lesions.

		ADC Value
Cystic	Mean ± SD	2.41 ± 0.56
	Range	1.2 – 3.22
Solid	Mean ± SD	1.63 ± 0.91
	Range	0.68 – 3.08

Table (4): Significance of diffusion pattern and ADC value in benign and malignant lesions.

		Benign	Malignant	Test value	P-value	Sig.
		No. = 12	No. = 8			
DWI	Non restricted	8 (66.6%)	0 (0.0%)	12.571*	0.000	HS
	Restricted	4 (33.3%)	8 (100.0%)			
Cystic	Mean ADC ± SD	2.52 ± 0.51	2.18 ± 0.65	1.227•	0.237	NS
	Range ADC	1.4 – 3.22	1.2 – 3			
Solid	Mean ADC± SD	2.19 ± 0.79	0.82 ± 0.10	4.472•	0.000	HS
	Range ADC	1.19 – 3.08	0.68 – 0.96			

Table (5): Histopathological results of the different lesions.

		Total no. = 20
Diagnosis	Mature cystic teratoma	2 (10%)
	Simple cyst	2 (10%)
	Mucinous cystadenoma	1 (5%)
	Hemorrahgic cyst	2 (10%)
	Fibrothecoma	1 (5%)
	Tubo-ovarian abscess	1 (5%)
	Fibroma	1 (5%)
	Serous cystadenoma	2 (10%)
	Papillary serous carcinoma	2 (10%)
	Granulosa cell tumor	2 (10%)
	Mucinous cystadenocarcinoma	2 (10%)
	Serous cystadenocarcinoma	2 (10%)
Outcome	Benign	12 (60%)
	Malignant	8 (40%)

Table (6): Table showing statistical results of MRI compared to pathology.

Variable	Sens%	Spec%	PPV%	NPV%
MRI	100%	100%	98.1%	100%

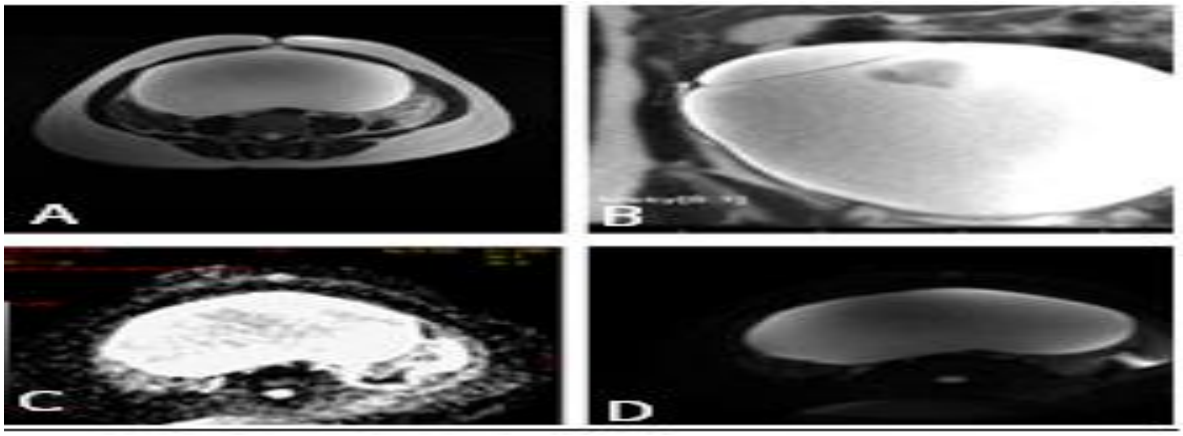

Figure (1): A case of left Serous ovarian cystadenoma , (A) Axial T2 weighted image, (B) coronal T2 weighted image, (C) Axial ADC image, (D) Axial T2 - fat suppression, the lesion elicits fluid iso- equivalent signal alteration, containing areas of predominant fluid signal, appears as low T1 & high T2 signal and being not suppressed in T2 fat suppression WIs with facilitated diffusion in DWI and high corresponding ADC values $3.1 \pm 0 \times {}^{10\text{-}3}$ mm^2/s, P value 1000.

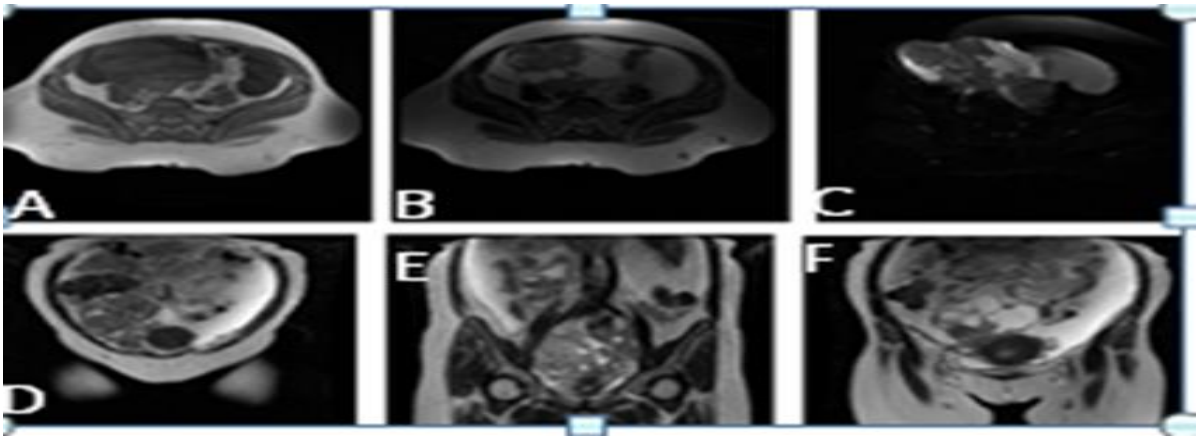

Figure (2): Bar A case of bilateral malignant mucinous neoplasm, (A) Axial T1 weighted image, (B) Axial T1 weighted image, (C) Axial ADC image, (D-E-F) coronal T2 weighted images. Bilateral larg ovarian mixed solid and cystic masses, the solid component shows heterogeneous T2, intermediate signal intensity on T1 WIs. with heterogeneous signal intensity on STIR. areas of restricted diffusion with corresponding ADC value of cystic portion and solid portion 2.55 ± 0.07 x 10-3 and 0.82 ± 0.2 X 10-3 mm2/s, P value 1000.

4. Discussion

MRI is a recent useful method to enhance the description and distinguish benign and malignant tumors, involving its basic conventional sequences and advanced Diffusion sequences[5] **.** In our study, we found that 15 % of our cases were solid, 60% were mixed and 25 % were only cystic this was close to the study done by Amir, [2] with 20 % of cases were solid, 55% were mixed and 25 %were only cystic. In the present study the sensitivity of MRI was 100%, specificity was 100%, PPV was Figure 2: A case of bilateral malignant mucinous neoplasm, (A) Axial T1 weighted image, (B) Axial T1 weighted image, (C) Axial ADC image, (D-E-F) coronal T2 weighted images. Bilateral larg ovarian mixed solid and cystic masses, the solid component shows heterogeneous T2, intermediate signal intensity on T1 WIs. with heterogeneous signal intensity on STIR. areas of restricted diffusion with corresponding ADC value of cystic portion and solid portion 2.55 ± 0.07 x 10-3 and 0.82 ± 0.2 X 10-3 mm2/s, P value 1000**.** 98.1% **,**and NPV 100% which coincide with the results in the study done by Mansour et al., 2020. [6] who found that the sensitivity of MRI was 96.43%, specificity was 95.83%, PPV was 96.43%, and NPV

95.83%. In our study, 100% of malignant lesions (8 malignant lesions) showed restricted diffusion with low ADC values. This agreed with Rajasri et al. [7] study conducted on 112 female patients with initial undetermined complex adnexal masses by ultrasound who concluded that an adnexal mass with restricted diffusion usually is a malignant lesion **.** In our study, we had 12 pathologically proven benign ovarian lesions, 8 cases showed facilitated diffusion and 4 cases showed restricted diffusion. This was in agreement with Nasr et al. [8] study that was conducted on 30 cases of different ovarian lesions, twenty-three cases were pathologically proven (classified to twelve benign and eleven malignant), Seven benign patients demonstrated enhanced diffusion**.** In the current study, no significance difference between benign and malignant tumors was found as regard to ADC value of cystic masses. Similarly, Adel et al. [9] found that the average ADC value of the cystic masses was (1.603 ± 0.49) × 10-3) mm 2/s for benign tumors, and (1.223 ± 0.53) × 10-3) mm 2/s for malignant tumors without significant difference**.** On the other hand, we found the average ADC value of the solid lesions was significantly different between benign and malignant tumors ($p < 0.001$). This agree with Lie et al. [10] who found that the mean ADC value of the solid lesions to be (1.69 ± 0.25) x 10-3) mm2/s for benign tumors, and (1.03 ± 0.22) x 10-3) mm2/s for malignant tumors which found to be significant**.** In our study, the sensitivity, specificity, PPV, NPV and accuracy of DWI imaging were 100%, 78.6%, 72.7%, 100%, 86. 4% respectively, according to ADC values of the solid masses. This was in agreement with Rahma et al. [11] study which concluded that the sensitivity, specificity, PPV, NPV, and accuracy of conventional MR imaging have all enhanced by the addition of DWI to it**.** In our study ,we found that ADC value ≤ 0.96 × 10-3 mm2/s is the optimal cut off for distinguishing between benign and malignant masses with sensitivity of 100%, specificity of 78.6%, PPV of 72.7%, NPV of 100% and accuracy of 86.4%, This was close to Khaledand Ahmed, [5] study carried on 20 female patients with different ovarian lesions subjected to DWI, they concluded that ADC value 0.9 × 10-3 mm2/s may be the optimal cutoff for distinguishing between benign and malignant masses with 100% specificity, 88.9% sensitivity, 75% NPV, 100% PPV and 91.7% accuracy.

5 .Conclusion

We conclude that MRI multi-parametric assessment -involving its basic conventional sequences and advanced Diffusion sequences- can aid the assessment or ruling out probable malignancy in adnexal masses.

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