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Magnetic Resonance Imaging of Suspicious Ovarian Lesions

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ABSTRACT

Background: Characterization of an ovarian lesion represents a diagnostic challenge; the optimal assessment of an adnexal mass requires a multidisciplinary approach, based on physical examination, laboratory tests and imaging techniques. Diagnostic imaging plays a crucial role in detection, characterization and staging of adnexal masses. Magnetic Resonance Imaging **(MRI)** is an essential problem solving tool to determine the site of origin of a pelvic mass and then to characterize an adnexal mass, especially in patients with indeterminate lesions.

Aim of the Work: The aim of the study is to evaluate role of MRI as a powerful and noninvasive technique which may effectively characterize and differentiate between various suspicious ovarian lesions.

Patients and Methods: The current study is a prospective analysis that evaluated 26 female patients with 36 suspicious ovarian lesions. The study was conducted at Radiology Department of El-Demerdash hospital. The patients were previously evaluated by ultrasound examination in the period from November 2017 to April 2018. The patients' age ranged from 12 to 65 years old (mean age 41± 15 SD). 4 patients presented by abdominal swelling (15%), 8 were complaining of chronic pelvic pain (30.7%), 10 came with menstrual irregularities (38%) and 4 (15%) cases were accidentally discovered during US examination.

Results: This study included 36 ovarian lesions in 26 patients (8 cases had bilateral masses). The age in cases with benign lesions ranged from 12 to 65 years (Mean age 37.31 ± 16.214 SD), While the age in cases with malignant lesions; ranged from 14 to 61 years. (Mean age 44.38±14.015 SD) .

Conclusion: As an advanced technique, dynamic contrast-enhanced MRI (DCE-MRI) plays an important role in tumor detection and characterization, subtyping, prediction of prognosis, treatment monitoring, and drug development.

Keywords: Magnetic Resonance Imaging, Suspicious Ovarian Lesions.

INTRODUCTION

Ovarian masses are a common finding in daily clinical practice and may be incidentally detected or identified in symptomatic patients. Characterization of an ovarian lesion represents a diagnostic challenge; it is of great importance in the preoperative setting in order to plan adequate therapeutic procedures and may influence patient's management. The optimal assessment of an adnexal mass requires a multidisciplinary approach, based on physical examination, laboratory tests and imaging techniques. Preoperative biopsy should not be performed in ovarian masses, particularly if the mass appears to be surgically resectable at the moment, as this invasive procedure raises the risk of spreading cancer cells worsening the prognosis so , diagnostic imaging plays a crucial role in detection, characterization and staging of adnexal masses [(1)].

Magnetic Resonance Imaging (MRI) is an essential problem solving tool to determine the site of origin of a pelvic mass and then to characterize an adnexal mass, especially in patients with indeterminate lesions [(2)].

The main advantages of MRI are the high contrast resolution with excellent soft tissue contrast and lack of ionizing radiation exposure, which is particularly important in young female patients [(2)]. MRI can produce images that are not only exquisite in structural details but can also provide functional information in tumors [(3)].

MRI provides high spatial resolution, such that morphology is very well visualized. With the aid of MRI, adnexal masses with morphologic characteristics that are indeterminate on trans-vaginal ultrasound can sometimes be better identified as benign or malignant [(4)].

AIM OF THE WORK

The aim of the study is to evaluate role of MRI as a powerful and noninvasive technique which may effectively characterize and differentiate between various suspicious ovarian lesions.

PATIENTS AND METHODS

The current study is a prospective analysis that evaluated 26 female patients with 36 suspicious ovarian lesions.

The study was conducted at Radiology Department of El-Demerdash hospital and other private centers.

The patients were previously evaluated by ultrasound examination in the period from November 2017 to April 2018. The study was approved by the ethical **Board of Ain Shams**

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University and an informed consent was obtained from the patient or her guardian.

The patients' age ranged from 12 to 65 years old (mean age 41+/- 15 SD).

4 patients presented by abdominal swelling (15%), 8 were complaining of chronic pelvic pain (30.7%), 10 came with menstrual irregularities (38%) and 4 (15%) cases were accidentally discovered during US examination.

All cases had been subjected to the following:

1-Full history taking with a special emphasis on age, parity, time of menopause, past history of gynecological troubles or operations and positive family history of gynecological malignancy .

2-Routine laboratory investigation for all patients including kidney functions.

3-Ultrasound examination: All patients had a preliminary pelvic ultrasound in the Gynecology Department, and simple functional cysts were excluded. The examination was done by trans-abdominal and trans-vaginal ultrasound approaches. Color Doppler was superimposed on masses to detect vascularity.

MR images were analyzed for the following:

- MR appearance of the tumor; whether cystic, solid or mixed.
- Involvement of one or both ovaries.
- Signal intensity of the tumor.
- Enhancement of the solid component if present.
- Wall thickness of the tumor and its enhancement.
- The presence of vegetations or solid components, their enhancement pattern and their size.
- The presence of associated findings such as ascites, infiltrated pelvic or para-aortic lymph nodes, peritoneal and omental deposits, the involvement of other pelvic organs.
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- ***Statistical analysis***

Data were coded and entered using the statistical package SPSS (Statistical Package for the Social Sciences) version 25. Data was summarized using mean, standard deviation, median, minimum and maximum in quantitative data and using frequency (count) and relative frequency (percentage) for categorical data. Standard diagnostic indices including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic efficacy were calculated as described by (Galen, 1980). Comparisons between quantitative variables were done using the non-parametric Mann-Whitney test. For comparing categorical data, Chi square test was performed. Exact test was used instead when the expected frequency is less than 5. ROC curve was constructed with area under curve analysis performed to detect best cutoff value of ADC for detection of malignancy. **P value less than 0.05** was considered as statistically significant.

Interpretation of DWI:

1- Qualitative analysis.

2- Quantitative analysis.

Statistical analysis

All patients imaging results were compared with the histo-pathological diagnosis after surgery.

RESULTS

Table 1: ADC values of examined lesions.

	Minimum	***Maximum***	***Mean (+/- SD)***	**P value**
Benign	0.50	2.30	1.28+/- 0.67	0.039
Malignant	0.30	1.10	0.71+/- 0.25	

Table 2: The cutoff values of benign vs malignant lesions

Area under curve	**P value**	**Cutoff value**	**Sensitivity (%)**	**Specificity (%)**	**PPV**	**NPV**	**Accuracy**
0.737	0.040	1.2	100	46.2	65	100	73.08

Table 3: Relation of type of TIC to pathology

		Pathology				**P value**
		M		**B**		
		Count	**%**	**Count**	**%**	
Curve	**1**	1	7.7%	9	69.2%	0.001
	2	1	7.7%	2	15.4%	
	3	11	84.6%	2	15.4%	

Table 4: Pattern of enhancement of examined lesions.

		Pathology				P value
		M		B		
		Count	%	Count	%	
Contrast enhancement	**Inhomogenous**	11	84.6%	1	7.7%	< 0.001
	Homogenous	2	15.4%	12	92.3%	

DISCUSSION

Ovarian masses are a common finding in daily clinical practice and may be incidentally discovered or identified in symptomatic patients. Characterization of an ovarian lesion represents a diagnostic challenge; it is very important before surgery in order to plan adequate therapeutic procedures and may influence patient's management [(1)].

Ultrasonography is used as the first-line imaging technique for detecting adnexal masses but with less accuracy for complex or indeterminate masses, even when combined with color Doppler imaging [(5)].

Pelvic magnetic resonance (MR) imaging has clearly been demonstrated to be the best imaging technique to characterize indeterminate or complex adnexal masses due to its excellent tissue contrast [(6)].

In this study, we investigated the diagnostic utility of the MRI in the diagnosis and characterization of the indeterminate ovarian lesions.

Diffusion-weighted imaging (DWI) is a potentially useful technique in the assessment of adnexal masses [(1)].

In this study, we found a significant difference in diffusion signal between benign and malignant tumors ***(p value <0.001).***

In our study all the malignant and 26% of the benign lesions showed high signal in diffusion "diffusion restriction". There were 2 benign lesions that showed restricted diffusion both were tubo-ovarian abscess.

We also found a significant difference in the mean ADC values between the benign lesions and the malignant tumors which are ***1.22+/-0.7SD and 0.73+/-0.3SD (***x 10^{-3} mm^2/S) respectively ***(P value 0.033).***

Similarly, ***Takeuchi and colleagues*** [(7)] found that the mean ADC values between the benign and malignant lesions differed significantly (*mean ADC* value in malignant tumors 1.03±0.19 while that of the benign tumors was 1.38±0.30 (x 10^{-3} mm^2/S).

In this study, the 2 lesions of the tubo-ovarian abscesses showed diffusion restriction "high signal in diffusion and low signal in ADC map". Their mean ADC value was ***0.55x10-3 mm2/s ± 0.07 SD***, which was low compared to that of benign lesions (which was ***1.4x10^{-3} mm^2/S ± 0.526 SD*** after the exclusion of the tubo-ovarian lesions).

In our study, the addition of the DWI improved the accuracy of the ***conventional MRI*** from the sensitivity of the conventional MRI was 84.62%, specificity was 92.31%, PPV was 91.67%, NPV was 85.71% and accuracy was 88.46% to sensitivity of 100%, specificity of 84.6 %, PPV of 86.67%, NPV of 100% and accuracy of 92.31%.

In their study, ***Li et al.*** [(8)] found that the accuracy of ***conventional MR imaging*** has increased from 87.0% to 93.1% after adding ***DWI*** to the conventional MR.

DCE-MRI is a non-invasive technique which can assess tissue perfusion and oxygenation within the tumor microenvironment [(9)].

DCE-MRI evaluates tumor perfusion and permeability of the tumor microenvironment following intravenous gadolinium administration. Semi-quantitative measures using dynamic signal intensity curves within specific regions of interest (ROI) have been more widely used to assess perfusion, such as in the assessment of adnexal masses [(10)].

Sohaib and colleagues described that malignant lesions show greater enhancement than benign lesions during the early phase of enhancement rather than the late phase of enhancement while benign ovarian tumors showed a gradual increase in enhancement without a well-defined peak, while, borderline ovarian tumors showed moderate initial enhancement followed by a plateau [(11)].

In our work, 9 cases with benign tumors(34.6%) and 1 case of malignant tumor (3.3%) showed type 1 TIC and 11 cases with malignant tumors (42.3%) and 2 cases with benign tumors (7.7%) showed type 3 TIC while 2 benign cases and 1 malignant cases showed type 2 curve**.**

In our study we found a significant difference in enhancement pattern between benign and malignant lesions, where of malignant 11 cases with malignant tumors and 1 case of benign tumors

showed inhomogenous enhancement compared to 12 cases of benign tumors and 1 case of benign lesions showed homogenous enhancement **(p value <0.001).**

Similarly, ***Li et al.*** found that there were statistically significant differences in enhancement patterns between benign and malignant ovarian tumors [(8)]**.**

According to Li et al. the possible explanation of different patterns of enhancement seen between benign and malignant ovarian tumors could be explained by the fragile neovasculature lacking a muscular coat, and due to high permeability/leakage, thecontrast agent uptake occurs rapidly, influencing contrast enhancement [(8)]**.**

CONCLUSION

Quantitative assessment of the tumour microenviroment can be derived from the apparent coefficient diffusion (ADC) which is generated from combining serial b-values**.** Hence, DWI can be used to assess changes in tumour cellularity over time in response to treatment. Acquisition of DWI and generation of ADC maps is simple, fast, and does not require intravenous contrast agents**.**

As an advanced technique, dynamic contrast-enhanced MRI (DCE-MRI) plays an important role in tumor detection and characterization, subtyping, prediction of prognosis, treatment monitoring, and drug development**.**

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