ISSN: 0974-2115
www.jchps.com Journal of Chemical and Pharmaceutical Sciences

Validity of Magnetic Resonance Imaging (MRI) in characterizing adnexal masses: a prospective study

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ABSTRACT

The aim of this was to determine whether Magnetic Resonance Imaging (MRI) images and enhancement features could help accurately in distinguishing benign from malignant adnexal masses. 84 women with clinically suspected adnexal masses were prospectively studied. MRI was carried out using T1, T2, and fat-suppressed before and after intravenous injection of contrast (gadolinium). The adnexal lesions were examined for several features including size, shape, character, signal intensity, and enhancement. All MR imaging features were categorized as benign or malignant without knowledge of clinical details, according to the imaging features which were compared with the surgical and pathological findings. Results revealed that out of 80 patients confirmed with surgery and histological evaluation, 64 (80%) of them were benign and 16 (20%) patients had malignant masses. The most common site of the adnexal masses in both malignant and benign were on the right site of the ovaries. The overall sensitivity of MRI for the diagnosis of malignancy was 93.75% and accuracy was 95%. Results of comparison between MRI imaging and histopathology found that 78 of the 80- adnexal masses were identified as tumor lesions by MRI; of which 63 were benign and 15 were malignant lesion. MRI is sensitive for differentiation benign and malignant adnexal masses.

KEY WORDS: MRI, Sensitivity, Ovary, Specificity, Adnexal Lesion.

1. INTRODUCTION

There is wide entities for diagnosis of masses of adnexa the range is wide between malignant and benign the risk is depend on tumor marker, features of imaging, menopausal status and age. There is multiple different modalities of imaging found to characterize masses of adnexa the magnetic resonance imaging and ultrasound are the most commonly diagnosis of adnexal lesions and provides good imaging in the management of such patients. (Griffin, 2010).

The primary modality of imaging for characterize masses of adnexal is ultrasound (US) (Griffin, 2010; Liu, 2007). MRI is a good module to provide information on content of masses of soft tissue using multiple relaxation properties seen in tissue types, the result of this information appear the character of masses of soft tissue (Outwater and Dunton, 1995; Huber, 2002).

The evaluation patients with adnexal lesions the MRI has become the important tool and solve the problem of adnexa most malignant and benign lesions can be diagnosed by MRI with high confidence and high accurate than other modalities for staging, characterization lesion and follow up (Huertas, 2006).

The objective of this study was to investigate if the magnetic resonance imaging (MRI) can differentiate adnexal mass whether it was benign or malignant on the basis of their morphologic features and enhancement patterns.

2. MATERIALS AND METHODS

Patients: During a period of 18 months (from December 2014 to June 2016), 84 consecutive patients (age range, 17–70 years; mean age, 30 years) with different clinical presentations (Table.1) were enrolled in this study.

Table.1. Clinical presentations of patients enrolled in the study

Clinical feature	No.
Irregular menses	50 (62%)
Pelvic pain &fever	15 (19%)
Palpable pelvic mass	9 (12%)
Urinary symptom	6 (7%)
Total	80 (100%)

They were referred from surgical department presented with adnexal masses by ultrasound examination who underwent preoperative MRI in department of radiology in Hilla teaching hospital, Iraq. Patients were passed to operative exploration for histopathological diagnosis. The median time from scanning to surgery was 35 days from initial ultrasound scanning (with MRI) to surgery.

Out of 84 cases enrolled in this study, four patients were excluded from the study because they refused surgical exploration. Only 80 patients were underwent surgical exploration throughout the study.

The following imaging features were used for diagnosis of malignant lesions on MRI: irregularity, vegetation on the wall, solid-cystic lesion, large size of the lesion presence septum in cystic lesion and early contrast

enhancement (Gadolinium) the presence of ascites or adenopathy were the factors more indicative of malignancy, while presence of fat, hemorrhage, no septum in cystic lesions and no contrast enhancement were the feature of benignancy.

Protocol of MRI: Multi-planar sequence of MRI 1.5 T units of Philips system with different coils for imaging of abdomen and pelvis was used in this investigation.

The sequences included T1 (longitudinal relaxation time), T2 (Transverse relaxation time), and fat suppression sequences before and after intravenous injection of contrast media (gadolinium) were used with different planes (axial, saggital, and coronal) to diagnose the adnexal masses with their different characteristics (shape, vegetation, intensity, size, regularity, texture, and homogeneity) and to look for soft tissue extension, ascites and lymph nodes metastasis. Coil of body was used only for imaging of pelvis for patients with severe ascites, obese, and those with large mass more than 15 cm in diameter. The MRI without known clinical features of the subjects was confirmed by two specialist radiologists.

3. RESULTS

Eighty patients presented in Hilla teaching hospital, Iraq, of having different clinical presentations. Results of distribution of adnexal masses in relation to age of patients are shown in table.2. Out of benign lesions (64; 80%), the majority were found in female age group 25-35 years and whereas majority of malignant lesions (16; 20%) were found in age group 55-65 years.

Results of histopathological findings of benign and malignant lesions revealed that out of 80 patients confirmed with surgery and histological evaluation, 64 (80%) of them were benign and 16 (20%) patients had malignant masses (Table.3).

The most common site of the adnexal masses in both malignant and benign were on the right site of the ovaries (Table.4). The overall sensitivity of MRI for the diagnosis of malignancy was 93.75% whereas Specificity was 96.8%. (Table-5).

Results revealed that the predominant feature of benign lesion was hemorrhage (Figure.1). For determination of benign lesion, the appearance of brightness (on T1-weighted image) in cyst indicating there is either a fat or blood content, while the remaining of bright lesion (on fat suppression sequence), fatty lesion was ruled out. In some cases, hemorrhage can be seen in malignant tumors the benign lesion was confirmed by administration of contrast (Gadolinium).

Results also revealed that other predominant features of benign lesion were found. Fat content was seen for demonstration of benign lesion as shown in the imaging of fat presence in fat suppression sequence (Figs.2 and 3). No septum in cystic adnexal lesions was also seen in some cases.

Table.5, reveals the features of malignancy which included solid-cystic lesion, solid only, cystic only, vegetation on the wall, large size of the lesion, the presence of ascites, and peritoneal invasion.

Solid-cystic lesion was the high percentage among the malignancy features seen (81.2%), followed by early contrast enhancement (43.7%), while the least percentage among the malignancy features was seen in solid only feature (6 %) (Table-5).

Figure.4, shows the presence of septa inside cystic adnexal lesion as one of malignancy features, indicating malignant lesion.

Results of comparison between MRI imaging and histopathology found that 78 of the 80 adnexal masses were identified as tumor lesions by MRI (with two cases as false positive); of which 63 were benign lesions and 15 were malignant lesion (Table.6).

Table.6, also shows that the sensitivity of MRI for detection of malignant lesions was 93.75%. Specificity: 98.4%, Positive predictive value: 93.75 % and Negative predictive value: 98.4%. Results also found that the accuracy of MRI was 95%.

Table.2. Distribution of adnexal mass in relation to age of patients

Age (Years)	No. (%)
17-25	9 (11.25%)
25-35	24 (30%)
35-45	20 (25%)
45-55	12 (15%)
55-65	11 (13.75%)
65-70	4 (5%)
Total	80 (100%)

Table.3. Histopathology of malignant and benign adnexal masses

Malignant Adnexal mass	No. (%)	Benign Adnexal mass	No. (%)
Papillary serous cyst adenocarcinoma	11 (68.75%)	Nonneoplastic ovarian cysts	28 (43.75%)
Mucinous cyst adenocarcinoma	3 (18.75%)	Endometrioma	9 (14%)
Endometrioid carcinoma	1 (6.25%)	Serous cystadenoma	12 (18.75%)
Poorly differentiated carcinoma	1 (6.25%%)	Teratoma	6 (9.5%)
Total	16(100%)	Fibroma or the coma	4 (6.25%)
		Mucinous cystadenoma	4 (6.25%)
		Hydrosalpinx	1 (1.5%)
		Total	*64 (100%)*

Table.4. Distribution of adnexal mass in relation to site of ovaries

Site	No. (%)
Right	50 (62.5%)
Left	30 (37.5%)
total	80 (100%)

Table.5. Characteristic Features of 16 malignant adnexal masses on MRI imaging presence

Feature	No. (%)	Feature	No. (%)
Diameter greater than 6 cm	6 /16 (37.5%)	Vegetation on the wall	3/16 (18.75%)
Solid only	1/16 (6 %)	Early enhancement	7/16 (43.75%)
Solid-cystic	13/16 (81.25%)	Peritoneal invasion	4/16 (25 %)
Cystic only	2/16 (12.5%)	Ascities	5/16 (31.25%)
Septum	5/16 (31.25%)	Lymphadenopathy	4/16 (25 %)

Table.6. Validity, positive, and negative predictive value for diagnosing malignant adnexal mass on MRI

	Malignant	Benign	Total
MRI positive	TP 15	FP 1	16
MRI negative	FN 1	TN 63	64
Total	16	64	80

Sensitivity: TP/TP+FN 15/15+1*100=93.75%
Specificity: TN/TN+FP 63/63+1*100=98.4%
Positive predictive value TP/FP+TP 15/15+1*100=93.75 %
Negative predictive value: TN/TN+FN 63/63+1 = 98.4%

Where, TP: true positive, TN: true negative, FP: false positive, FN: false negative.

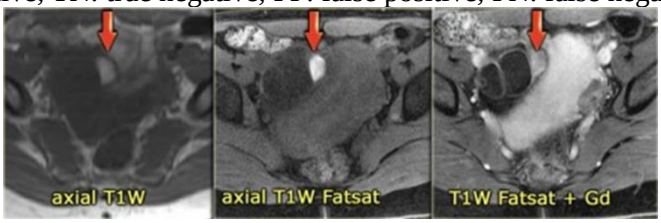

Figure.1. Right benign adnexal mass (endometrioma) detected using T1-weighted image

The complex cyst is bright, indicating either fat or blood content. On T1-weighted image with fat suppression technique**,** the lesion remains bright, ruling out a fatty lesion. After the administration of contrast (Gadolinium) there is no enhancement, confirming that this lesion is benign.

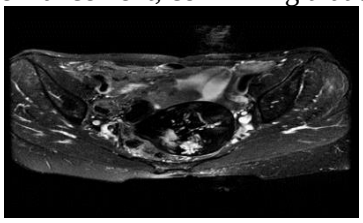

Figure.2. Left benign adnexal mass. Axial T2 - weighted spair

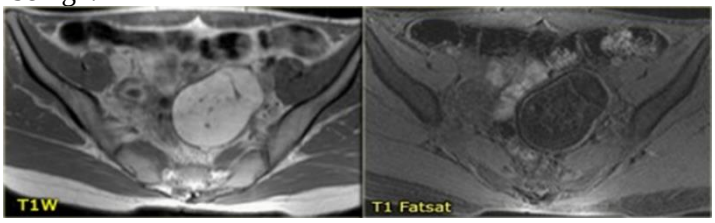

Figure.3. Left benign adnexal mass. In T1-weighted (T1W)

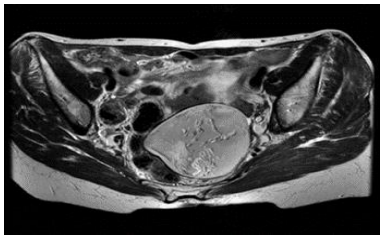

Figure.4. Right Malignant adnexal mass. Axial T2-weighted spair

DISCUSSION

Adnexal lesions are seen in women of all ages. In reproductive age some benign ovarian conditions can be seen. The MRI has good modalities to diagnosis malignant lesions of adnexal on specific relaxation time and multiple sequence (Rajkotia, 2006).

This study focused on MRI features that are most useful to predict malignancy and emphasized how these features differ from those of benign disease. Although many physicians are understandably concerned about the failure to detect an ovarian malignancy, it is important to realize that the majority of adnexal masses, particularly in premenopausal women, are benign. (ACOG, 2007; Moszynski, 2006).

Although MRI imaging is better reserved for problem solving and it is more accurate for diagnosis compared with ultra sound (which is non-diagnostic), it is more expensive.

Both benign and malignant masses of ovary can be distinguish on MRI according to texture whether cystic or solid, shape, size, invasion of adjacent tissue, and can be accurately diagnosed on the basis of T1-weighted, T2-weighted, and Fat-suppressed T1-weighted MR imaging findings. This result is similar to that finding obtained by (Jeong, 2000).

MR imaging allows identification of blood products within hemorrhagic masses that may mimic solid tumor. Fat-suppressed T1-weighted MR images may reveal small amounts of fat, which allow the diagnosis of benign adnexal masses. Contrast-enhanced T1-weighted MR imaging depicts features of malignancy such as enhancing mural nodules and/or enhancing solid areas with or without necrosis (Jeong, 2000).

The benign diagnosis on basis of fat, cystic, no septa and no invasion of adjacent structure while the malignant lesion contains solid component, nodules, vegetations and invasion of adjacent structure with irregular shape. However the accuracy depends on results of histopathology findings. MR imaging has been shown to have potential in the characterization of adnexal masses. This study confirmed this finding as MRI has good modalities for characterization of adnexal masses. Several authors also reported such result (Medl, 1995; Hricak, 2000).

Using contrast enhancement in MRI is an excellent method for characterization of adnexal masses due to that internal architecture of complex adnexal masses can be appeared obviously. In addition, multiple sequences in MRI allow accurate identification of the origin of adnexal mass lesions.

The result of our study showed that the overall diagnostic accuracy of MRI was 95% for distinguishing malignant from benign adnexal lesions as compared to those findings reported previously by several authors (Hricak, 2000; Scoutt, 1994).

Study also found that malignant adnexal mass has strong and early enhancement than benign adnexal mass. This pattern of greater enhancement is similar to the observations made in studying tumors in other parts of body (Padhani and Husband, 2001). MRI imaging is highly accurate in the diagnosis of lesion in adnexal and the best predictors of malignancy are solid in cystic lesion and early contrast enhancement.

Results of this study revealed that the sensitivity of MRI for identifying malignancy was 93.75%. This result is closer to that obtained by Sohaib, (2003) who found that the sensitivity of MRI for diagnosis malignant adnexal mass was 95%, while it was less than that obtained by Kurtz, (1999) whose found that the sensitivity of MRI is 98%. The differences in sensitivity values may be attributed to type of MRI apparatus, Manufacturer Company, and number of samples of the study.

4. CONCLUSION

On the basis of the findings, the study concludes that MRI is good modality for differentiation of benign and malignant adnexal masses. Certain imaging features and the degree of enhancement on MRI images are helpful in differentiating adnexal masses, despite some overlap between the adnexal masses whether benign or malignant (as result cannot depend on MRI preoperatively to decide not to do surgery). Thus, imaging findings may contribute incremental value to clinical parameters in providing prognostic information, consequently improving the quality of the data used in therapeutic planning.

5. ACKNOWLEDGEMENTS

Author is grateful to Department of Radiology, Hila teaching hospital, Iraq, for great support and taking MR images. Author is also grateful to Prof. Alaa H. Al-Charrakh for critical review of the manuscript.

Conflicts Of Interest: There are no conflicts of interest.

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