The validity of ultrasonography (US) and magnetic resonance imaging (MRI) in characterizing adnexal masses(prospective study)

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الخلاصة

اجريت دراسة مقطعيه لثمانين مريضة للفترة من كانون الثاني 2009 كانون الاول 2011 يشتبه بإصابتهم بتكتل الحوض الجنبي ،تم فحصهم بالسونار لتشخيص كون التكتل كيسي أم صلب وحجم الكيس ثم اجراء الرنين المغناطيسي لحالات التكتل الصلبوالكيسي قبل العملية،اعتبرت المعايير الاتيه اساس في التميز كون التكتل حميد أم خبيث (نوعية ودرجة اخذ التكتل الصلب للصبغ وقابليته على تكوين الاوعيه الدمويه ،وقياس درجة التكلس)

اظهرت هذه الدراسه ان التكتل الذي يحتوي على الخراج بعد اجراء الرنين المغناطيسي له يمكن تشخيصه بانه له قابليه على اخذ الجدار فقط للصبغه بينما الورم الخبيث له قابليه مختلفة لأخذ ألصبغه بالاضافه إلى ذلك الورم الخبيث له قابليه عاليه على تكوين الاوعيه الدمويه ،بينما الورم الحميد له درجه متوسطه على اخذ ألصبغه

نستنتج من هذه الدراسه هناك بعض الفحوصات ودرجة اخذ الورم التكتلي للصبغه بامكانها أن تميز كون التكتل حميد او خبيث .

Abstract

To determine whether ultrasonography and MRI images on the basis of their morphologic features and enhancement patterns. could help accurately distinguish benign adnexal masses from malignant .

Between January 2009and December 2011, prospectively studied 80 women (mean age 30 years, range 17 to 70 years) with clinically suspected adnexal masses. A single experienced sonographer performed transabdominal and transvaginal greyscale spectral and colour Doppler examinations. MRI was carried out on a 1.5T system using T1, T2 and fat-suppressed T1-weighted sequences before and after intravenous injection of gadolinium. The adnexal lesions were examined for several features including size, shape, character (solid–cystic), signal intensity, and enhancement.

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Secondary signs such as ascites, peritoneal disease, and lymphadenopathy were noted. We compared the imaging features with the surgical and pathologic findings. 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. .

Sixty four (80%) cases of benign and 16(20%) cases of malignant on histopathology .Mean age (30 year),size of mass range from 1-14 cm .Both MRI and US correctly diagnosed 11 cases with malignant and false negative diagnosis 1 case with malignant lesion , MRI correctly diagnosed 4 cases with malignant lesions, which on US were thought to be benign ., both MRI and US correctly diagnosed 45 cases with benign lesions . MRI correctly diagnosed 18cases with benign lesion(s), which on US were thought to be malignant. For characterizing lesions as malignant, the sensitivity of MRI were 93.75 %, and of US were 68.75 % , the US features were suggestive of malignancy (large masses and solid-cystic lesions with nodules).

MRI is more sensitive than US for differentiation benign and malignant adnexal masses.

Introduction

The differential diagnosis for adnexal masses is wide, encompassing a range of benign, borderline, and malignant entities. Stratification of risk is made on age, menopausal status, imaging features, and tumor markers. This review outlines the different imaging modalities available to characterize adnexal masses, describes the typical ultrasound and magnetic resonance imaging features of the most commonly encountered adnexal lesions, and provides a suggested imaging algorithm in the management of such patients(1)

Ultrasonography (US) continues to be the primary imaging modality used to identify and characterize adnexal masses (1,2). The collective experience from numerous centers worldwide has provided a wealth of information that allows accurate characterization of about 90% of adnexal masses on the basis of their US features (3). Adequate characterization of an adnexal mass is important both to determine which patients need surgery and to help define the type of surgery and whether a surgical subspecialist is needed (4)

MR imaging has become an important tool in the evaluation of patients with adnexal disease, and its role continues to evolve. Some benign entities can be diagnosed by MR imaging with a high grade of confidence, such as teratomas, endometriomas, simple and hemorrhagic cysts, fibromas, and hydrosalpinx. In cases of malignant lesions, MR imaging may be more accurate than other modalities for lesion characterization, staging, and follow-up(5).

Aim of study

The purpose of this study was to determine if the adnexal masses depicted on ultrasound and magnetic resonance imaging (MRI) images can be differentiated on the basis of their morphologic features and enhancement patterns or not .

Patients and methods

Between January 2009 and December 2011, 80consecutive patients (age range, 17–70 years; mean age, 30 years;) presented with adnexal masses by ultrasound examination underwent preoperative MRI in department of radiology in Hilla teaching hospital followed by operative exploration , all cases were done in department of surgery in the same hospital. The median time from scanning to surgery was 35 days (range, 2 days to 70 days). between initial ultrasound scanning with MRI and surgery.

We used a 1.5-T unit MRI to perform T1-, T2-, and fat-suppressed T1-weighted sequences before and after IV injection of gadolinium. The adnexal lesions were examined for several features including size, shape, character (solid–cystic), vegetation, signal intensity, and enhancement. Secondary signs such as ascites, peritoneal disease, and lymphadenopathy were noted. We compared the imaging features with the surgical and pathologic findings.

Multiple logistic regression analysis was performed on 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.

Abnormal US results were defined as detection of a complex (noncystic) and/or solid ovarian or adnexal mass, which was 5 cm or larger along its longest axis in a premenopausal woman and of any size in a postmenopausal woman. Complex and solid characteristics included heterogeneous and/or hyperechoic internal echoes, a wall thickness of 3 mm or greater, wall nodularity, solid components, and internal septa at least 2 mm thick.

When the results of physical examination and pelvic US were equivocal or negative, an additional inclusion criterion could be detection of complex ascites (internal echoes, septa) at US. For evaluation of the ovarian or adnexal abnormality, the performances of US,Doppler US, and MR imaging in diagnosis of malignancy were compared. Conventional US could be included in this analysis because abnormal results at conventional US were an admission criterion. For evaluation of spread into the extraovarian pelvis and the abdomen, the performances of conventional US and MR imaging were compared.

Women were excluded from the study if they could not provide informed medical consent or if they were not a candidate for or did not need complete pelvic-abdominal surgical exploration. Other exclusion criteria were pregnancy and prior pelvic-abdominal laparoscopy or surgery within 6 months of entry into the study.

Conventional and Doppler US Protocol

State-of-the-art commercially available US equipment was used. The systems used were the Philips 3 HD and the model 128XP and 128 XP/10 platforms (Acuson, Mountain View, Calif). All machines had transabdominal and endovaginal probes with maximal frequencies of 2–5 MHz and 5–7 MHz, respectively. All machines had both color and pulsed Doppler capability. Whenever possible, Doppler US of the ovarian or adnexal abnormality was performed endovaginally; transabdominal Doppler US of the abnormality was reserved for studies with nondiagnostic results. Premenopausal women were scheduled for US within 8 days of the start of their menstrual cycles . The extraovarian pelvis was evaluated with combined endovaginal and trans abdominal US, whereas the abdomen was analyzed transabdominally.

MR Imaging Protocol

All sites used 1.5-T units (Philips Medical Systems). MR imaging was performed with a multicoil array or a built-in body coil. Whenever possible, the multicoil array was used for pelvic imaging with the body coil reserved for abdominal imaging. However, the body coil alone was used for imaging the pelvis and abdomen in the following situations: a mass larger than 15 cm in diameter or a patient with severe obesity or ascites.

The pelvis was imaged with an axial fast spin-echo T2-weighted sequence (5,000–6,000/102–126 [repetition time msec/echo time msec]) with an echo train length of 16, a 5–10-mm section thickness, and a 0–2.5-mm intersection gap. The matrix size was 256 × 256 with two signals acquired. This sequence was repeated in the coronal and sagittal planes as indicated. An axial T1-weighted spin-echo sequence (600–800/11–20) with spatial resolution similar to that of the T2-weighted sequence was then performed. The T1-weighted sequence was repeated with fat suppression after intravenous injection of 10–20 mL of gadolinium chelate.

The remainder of the abdomen and pelvis was imaged with an axial T2-weighted fast spin-echo sequence and an axial fat-suppressed T1-weighted spin-echo sequence. The T2-weighted sequence (4,000/102–126) had an echo train length of 16, an 8–10-mm section thickness, and a 1.0–2.5-mm gap. The matrix was 256 × 192 or 256 with two to four signals acquired. This sequence was repeated in the coronal and sagittal planes as indicated. The T1-weighted sequence (400–600/11–20) had an 8–10-mm section thickness with a 2-mm gap. The matrix was 256 × 128–192 with two signals acquire.

MR Image Analysis

The MR images were evaluated by two radiologists in consensus without knowledge of the surgical or pathologic findings. The MR imaging features were then correlated with the surgical and pathologic findings.

The imaging features documented include the number of adnexal masses per patient, origin (ovarian or extraovarian), shape, size, and content of lesion (solid only, mainly solid, solid–cystic, mainly cystic, and cystic only). If a wall could be identified, its thickness, character, and enhancement were noted. If septa were present in the lesion, the number, thickness, character, and enhancement of the septa were recorded. Any vegetation appearing on the wall or the septum of the lesion was measured and noted. In addition, we documented the presence of a hemorrhage or fat. We determined that a hemorrhage was present if signal intensity was high on T1-weighted spin-echo and fat-suppressed T1-weighted MR sequences. We determined that fat was present if the lesion showed high signal on T1-weighted MR images that lost signal on the fat-suppressed T1-weighted MR images. Tissue with low signal intensity on T2-weighted MR images (i.e., ≤ signal intensity of skeletal muscle) was also noted. Such low-signal-intensity tissue is indicative of fibrous tissue, which is found in benign ovarian tumors (7).

Results

Eighty patients presented in Hilla teaching hospital of having different presentation table (1) show clinical presentation of each patient ,age of patients included in this study range from 17-70 years mean age (30 year) table(2) show age of patients ,then ultrasound examination done for all of them ,by ultrasound examination found the patients to cystic or solid adnexal mass, size of mass ,appearance ,presence sludge ,nodule of absent ,then underwent MRI examination in department of radiology in Hilla teaching hospital follow by operative exploration in department of surgery in the same hospital during period January 2009 and December 2011 . All patients underwent operative exploration with histopathological examination and compare with preoperative MRI examination .Regarding the sizes of mass range from 1-14 cm .

In all 80 patients the diagnosis was confirmed with surgery and histological evaluation which included 64(80%)patients have benign and 16 (20%) patients have malignant , table (3a,b) show histopathlogical finding of benign and malignant lesions .The most common site of the adnexal masses in both malignant and benign on right side as shown in table (4).

Majority of benign lesions 16(20%) were found in female age group 25-37 year and majority of malignant lesions 16(20%) found in age group range 38-50 years).

A total of 80 lesions—64(80%) benign and 16(20%) malignant lesions—were examined. On MR imaging, . The overall sensitivity of MRI for the diagnosis of malignancy was 93.75%. On univariate analysis, the imaging features associated with malignancy were a solid–cystic lesion, irregularity, and vegetation on the wall and septum in a cystic lesion, the large size of the lesion, an early enhancement on dynamic contrast-enhanced MR images, and the presence of ascites, peritoneal disease, or adenopathy. On multiple logistic regression analysis, ascites and vegetation in a cystic lesion were the factors most significantly indicative of malignancy Sixteen (20%) cases who have malignant on histopathology , both MRI and US correctly diagnosed 11 cases with malignant and not correctly diagnoses 1 case with malignant lesion . MRI correctly diagnosed 4 cases with malignant lesion(s), which on US were thought to be benign.

Sixty four (80%) cases who have benign on histopathology , both MRI and US correctly diagnosed 45 cases with benign lesions and not correctly diagnosis 1 case with benign lesion . MRI correctly diagnosed 18 cases with benign lesion(s), which on US were thought to be malignant .

For characterizing lesions as malignant, the sensitivity of MRI were 93.75 %, and of US were 68.75 %, as shown in table (5 and 6). Sixteen masses were malignant and 64 benign. All masses with a markedly hyperechoic solid component or no solid component were benign. For masses with a nonhyperechoic solid component, additional features that allowed statistically significant discrimination of benignity from malignancy were, in decreasing order of importance, (a) location of flow at conventional color Doppler imaging, (b) amount of free intraperitoneal fluid, and (c) presence and thickness of septations .

Table 1.clinical presentation of patients

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

Table 2. :Distribusion of adnexal mass in relation to age of patients

Age	Number
17-25years	9 (11.25%)
25-35 years	24 (30%)
35-45 years	20 (25%)
45-55 years	12 (15%)
55-65 years	11 (13.75%)
65-70 years	4 (5%)
total	80 (100%)

Table 3. a. histopathology of malignant adnexal masses 16 cases

Adnexal mass	No.
Papillary serous cyst adenocarcinoma	12(75.25%)
Mucinous cyst adenocarcinoma	3 (18.75%)
Endometrioid carcinoma	1 (6.25%)
Poorly differentiated carcinoma	1 (6.25%%)
Total	16(100%)

Table 3.b. histopathology of benign adnexal masses 64 cases .

Adnexal mass	No.
Nonneoplastic ovarian cysts	28 (43.75%)
Endometrioma	9 (14%)
Serous cystadenoma	12 (18.75%)
Teratoma	6 (9.5%)
Fibroma or thecoma	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

Side	number
Right	50 (62.5%)
Left	30 (37.5%)
total	80 (100%)

Table 5: 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 62/62+2*100=96.8%
Positive predictive value TP/FP+TP 15/15+1*100=93.75 %
Negative predictive value :TN/TN+FN 63/63+1 = 98.4%

- **TP:true positive**
- **TN:true negative**
- **FP:false positive**
- **FN:false negative**

Table 6: validity ,positive and negative predictive value for diagnosing malignant adnexal mass on US

	Malignant	Benign	total
US positive	TP 11	FP 19	30
US negative	FN 5	TN 45	50
Total	16	64	80

Sensitivity :TP/TP+FN 11/11+5*100=68.75 %
Specificity :TN/TN+FP 45/45+19*100=70%
Positive predictive value TP/FP+TP 11/19+11*100=36.6 %
Negative predictive value :TN/TN+FN 45/45+5 *100=90 %

- **TP:true positive**
- **TN:true negative**
- **FP:false positive**
- **FN: false negative**

Discussion

The main goal of imaging in the evaluation of an adnexal mass is the detection of malignancy (7). The standard of care for a suspected malignant adnexal mass is staging laparotomy with tumor debulking, which is performed preferably by an oncologic gynecologist (8). Ultrasonography (US) is the primary imaging modality for the assessment and characterization of adnexal masses, and the US features that indicate benignity are well established (9-18). However, the reported specificity of US for the diagnosis of benignity varies from 60% to 98%. In particular, as many as 20% of adnexal lesions in premenopausal women are classified as indeterminate by using US, even when they are interpreted in conjunction with clinical findings (18).

MR imaging has been shown to have potential in the characterization of adnexal masses, in this study finding that MRI is superior to US in characterization of adnexal masses this result similar to results of two studies (19,20) demonstrated that MR imaging with gadolinium-based contrast material enhancement is superior to US.

Adnexal masses are common in women of all ages. A range of physiological and benign ovarian conditions that develop in women, especially in the reproductive age, and adnexal malignancies can be evaluated with magnetic resonance imaging (MRI). Management of women with adnexal masses is frequently guided by imaging findings; therefore, precise characterization of adnexal pathology should be performed whenever possible. Magnetic resonance imaging is useful in characterization of adnexal masses that are not completely evaluated by ultrasound because it can provide additional information on soft tissue composition of adnexal masses based on specific tissue relaxation times and allows multiplanar imaging at large field of view to define the origin and extent of pelvic pathology. (21).

In this study the sensitivity of MRI for identifying malignancy was 93.75% and its specificity was 96% , which is a rate close to obtained by Adusumilli S et al (22) .

In this study the sensitivity and specifity is high this finding goes with finding of Kurtz (23) whose found the sensitivity of MRI is 98% and specificity 95% .

For the adnexa, the intent of this study was not to evaluate the efficacy of screening or mass detection. Rather, because all of the patients had a mass detected at US, the intent was to evaluate the abilities of US ,Doppler US and MR imaging to allow diagnosis of malignancy in the mass. For this application, the estimated areas revealed that MR imaging were superior to US and Doppler US .

US is often the initial imaging study in evaluation of a suspected adnexal abnormality. If a complex or solid adnexal mass and abdominal spread are detected with US, Similarly, MR imaging allow accurate diagnosis of a complex or solid adnexal mass Because of the importance of not understaging abdominal malignancy as disease limited to the pelvis, if stage III cancer is not detected at initial abdominal US or MR imaging should be performed because of their higher sensitivities in staging. Whatever the modality used, it is hoped that correct staging of advanced disease will lead to appropriate referral to a specialist in gynecologic oncology.

In this study we focused on US and MRI features that are most useful to predict malignancy and will emphasize 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 (3,24,25). We will review the distinguishing US features that can be used confidently identify the majority of common benign masses. With this knowledge, we can avoid creating unnecessary concern for the patient or the referring physician while remaining vigilant for adnexal malignancy. Masses due to ectopic pregnancy and adnexal torsion are beyond the scope of our discussion.

The finding in this study Magnetic resonance (MR) imaging is better reserved for problem solving when US findings are nondiagnostic or equivocal because, although it is more accurate for diagnosis, it is also more expensive. The signal intensity characteristics of ovarian masses make possible a systematic approach to diagnosis. Mature cystic teratomas, cysts, endometriomas, leiomyomas, fibromas, and other lesions can be accurately diagnosed on the basis of T1-weighted, T2-weighted, and fat-saturated T1-weighted MR imaging findings this result similar to finding by Jeong (26) .

Many of the most common causes of lesions that may mimic an adnexal mass (eg, small simple cysts) require no invasive testing. In the interests of efficiency and practicality, patients with suspect adnexal masses initially undergo pelvic US. Although endovaginal US can depict smaller lesions and internal features of masses (eg, papillary projections), it is not clear whether endovaginal US should always be performed in preference to transabdominal US (27–29). The more limited field of view and scanning windows used in endovaginal US may result in failure to identify abnormalities lying higher in the pelvis, particularly in patients with enlarged myomatous uteri (27-29).

Endovaginal US may be performed if transabdominal US findings are nondiagnostic; it may also be performed as an initial examination, followed by a brief transabdominal evaluation if the entire uterus and ovaries are not visualized endovaginally. Both conventional and Doppler US are less accurate than MR imaging in diagnosing ovarian malignancy (30–32). However, because it is impractical to perform MR imaging in all patients with abnormalities, this modality is reserved for uncertain or problematic cases.

Conclusion

On the basis of the findings, we conclude:

1 MRI is more sensitive than US for differentiation benign and malignant adnexal masses

2- That 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).

3- 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.

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