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Study of Role of Ultrasound and Magnetic Resonance Imaging in Adnexal Masses

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ABSTRACT
The objective of this study is to evaluate the comparative effectiveness of ultrasound and MRI in the assessment of adnexal mass lesions, correlating these findings with clinical outcomes and surgical results. The inclusion criteria encompassed clinically suspected adnexal mass lesions as well as those identified incidentally through ultrasonography. In this investigation, all 30 participants underwent ultrasonography, followed by MRI for each patient. The diagnostic outcomes from both imaging modalities were then compared against definitive results, which included histopathological analysis, surgical findings, or follow-up data. It is noted that 60% of ovarian tumors and 85% of malignant ovarian neoplasms are classified as ovarian epithelial neoplasms. The ultrasonography identified a total of 19 benign lesions and 11 malignant cases. In contrast, MRI revealed 21 cases as benign and 9 as malignant. Among the 30 cases, six were classified as malignant via ultrasound, comprising two serous cystadenocarcinomas, two mucinous cystadenocarcinomas, one serous papillary cystadenocarcinoma of the fallopian tube and one malignant tubo-ovarian mass. All six cases were consistently diagnosed as such on MRI and histopathological examination. However, one case, which was indeterminate on both ultrasound and MRI, was ultimately identified as a dysgerminoma upon histopathological evaluation. The study demonstrated that for the characterization of lesions as benign, MRI exhibited sensitivity, specificity and accuracy rates of 94.7%, 90.0% and 65%, respectively, while ultrasound showed sensitivity, specificity and accuracy rates of 94.7%, 90.9% and 70%, respectively. Ultrasound proves to be a sensitive initial imaging modality for the detection of adnexal lesions and serves as the primary triage method prior to treatment. MRI is particularly beneficial for the further evaluation of indeterminate cases and those with suspicious malignancies that were not conclusively diagnosed through ultrasound.

INTRODUCTION

The primary aim of imaging in the evaluation of an adnexal mass is to differentiate malignant and benign diseases to plan the appropriate treatment protocol. Management options range from radical staging surgery for suspected ovarian malignancy, less invasive surgery (laparoscopy) for likely benign tumors and conservative nonsurgical management[1]. Since there is a considerable difference between these types of operations, it is essential to make an appropriate diagnosis. Adnexal masses are a common clinical problem. The incidence of women undergoing surgery for suspicious adnexal masses ranges from 5-10%, of which <25% prove to be malignant. The clinically diagnosed adnexal lesions are, confirmed following an exploratory surgery and histopathological examination. The nature of an adnexal mass, whether benign or malignant, is often not evident before surgical exploration or histopathological examination. Imaging facilitates optimal differentiation of benign from malignant adnexal masses and thus guides in appropriate subspecialty referral, necessary preoperative planning and counseling of the patient[2]. Ultrasonography is generally the first-line investigation in the evaluation of suspected adnexal mass as it is widely available, relatively less cost and has high sensitivity[2-4]. Magnetic resonance imaging helps in the characterization of adnexal masses that are not wholly evaluated by ultrasound as it can provide additional information on soft tissue composition of adnexal masses based on specific tissue relaxation times and allows multiplanar imaging to define the origin and extent of pelvic pathology.

MATERIALS AND METHODS

The subjects of this study are the patients who get referred to the department of Radio-diagnosis with a clinically suspected adnexal mass, detected with adnexal mass incidentally on ultrasonography or patients with adnexal masses with indeterminate/ inconclusive diagnosis on ultrasonography.

Inclusion Criteria:

- Clinically suspected cases of adnexal mass lesions.
- Adnexal mass lesions found incidentally on ultrasonography.

Exclusion Criteria:

- All midline uterine mass lesions.
- Clinically and sonologically proved cases of ectopic pregnancy.
- Patients who are having a history of claustrophobia.

All Patients who are having a history of metallic implants insertion, cardiac pacemakers, metallic foreign body insitu. Based on the figures available on the sensitivity of Ultrasonography and Magnetic Resonance Imaging in the literature and with 95% confidence and 20% precision, the estimated sample size was 30 patients and our study included 30 patients. All patients referred to the department of radiology for Ultrasonography and Magnetic Resonance Imaging of adnexal masses were enrolled in the study following the inclusion and exclusion criteria. A detailed clinical history and written informed consent were obtained from the patients. Ultrasonography of pelvis was performed on every patient on Philips HD 11 instrument with the curvilinear transducer of 2-5Hz, and Transvaginal Ultrasonography was performed with a transducer of 4-8 Hz whenever required. Magnetic resonance imaging of pelvis was performed with a GE Signa 3 Tesla MRI machine. A pelvic phased-array coil was used in most cases, in cases where lesions were large., a body coil was used for better coverage. Intravenous contrast was given as and when necessary. The patients were followed up with histopathology, surgical/operative findings and follow up imaging.

Following Sequences were Used in the Study:

- Axial T1 weighted spin-echo sequence utilized a TR of 900 ms, TE 18 ms, field of view (FOV) 37 cm, slice thickness 6 mm, spacing 1.5-2.0 mm, NEX 3.0, 512X256 matrix.
- Axial T2 weighted fast spin-echo sequence utilized a TR 5200 ms, TE 42 ms, FOV 26 cm, slice thickness 6mm, spacing 1.5-2.0 mm, NEX 4.0, bandwidth-62.5, 512x256 matrix.
- Sagittal T2 weighted fast spin-echo sequence from one femoral head to the other utilized a TR of 3740 ms, TE 110 ms, FOV 26 cm, slice thickness 6.0 mm, spacing 1.5 mm, NEX 4.0, bandwidth 41.67, 512x256 matrix.
- Coronal T2 weighted fast spin-echo sequence utilized a TR 3540 ms, TE 78 ms, FOV 39 cm, slice thickness 6.0 mm, spacing 1.5-2.0mm,NEX 4.0, bandwidth 62.5, 512x256 matrix.

RESULTS AND DISCUSSIONS

Table 1: MRI Diagnosis

MRI Diagnosis	Number (30)	Percentage
Serous Cystadenoma	2	6.66
Mucinous Cystadenoma	2	6.66
Serous Cystadenocarcinoma	3	10
Mucinous Cystadenocarcinoma	2	6.66
Solid Benign Ovarian Tumors	4	13.33
Other Carcinomas	4	13.33
Dermoid	2	6.66
Pedunculated/Subserosa l Fibroid	1	3.33
Hemorrhagic Cyst	3	10
Tubo-Ovarian Abscess	2	6.66
Simple Ovarian Cyst	2	6.66
Endometriosis	2	6.66
Indeterminate	1	3.33

Table 2: USG for Malignant Lesions

Malignant			
	Disease Present	**Disease Absent**	
Positive	4	1	5
Negative	7	18	24
Total	11	19	30

Table 3: Sensitivity and Specificity of Ultrasonography

Usg Diagnosis	Benign	Malignant
Sensitivity%	89.4	36.36
Specificity%	36.36	89.4
Ppv%	89.4	66.66
Npv%	36.36	70.83
Accuracy%	27.5	52.5

The goal of imaging in the evaluation of an adnexal mass is to differentiate malignant and benign masses to plan appropriate treatment algorithms required[1]. Ultrasonography (USG) is an established method to detect and characterize a suspected adnexal mass. It is a basic triage method before treatment[4].**Magnetic resonance (MR)** imaging should be better reserved for **problem-solving** when USG findings are non-diagnostic or equivocal[5-9]. Adnexal masses present as a diagnostic challenge. The benign adnexal masses are much more in number compared to the malignant ones. Determination of appropriate suspicion for malignancy is critical and is based mainly on imaging appearance[6]. In the present study, all the **30 patients** underwent Transabdominal Ultrasonography and Transvaginal Ultrasonography was performed wherever applicable. MRI was performed on all patients and the diagnosis of both USG and MRI was compared with the final results that included histopathology, operative findings, or follow up. Most common presenting complains in the current study was abdominal pain predominantly confined to lower abdomen, which comprised of 13 of 30 cases (43.3%) followed by abdominal mass/lump 7 cases (23.3%) and abdominal distension 5 cases (16.6%), menstrual irregularity in 5 cases (16.6%). In the present study more number of benign lesions 19 of 30 cases (63.3%) were detected than malignant lesions 11 of 30 cases (36.6%), which is in concordance with the study conducted by Sohaib *et al.* where 43 (60%) had benign lesions and 29 (40%) had malignant masses. 60% of all ovarian tumors and 85% of malignant ovarian neoplasms are ovarian epithelial neoplasms[10]. Out of 30 cases, 19 cases were benign and 11 cases were malignant. The maximum number of cases were benign on both USG and MRI. On USG total number of benign lesions was 19 and the total number of malignancies was 11. However, on MRI, 21 cases were mild and 9 cases were malignant. Out of all the 19 benign cases on USG, one case of pedunculated subserosal fibroid was wrongly diagnosed as a malignant adnexal lesion due to its complex appearance as a solid cystic lesion with increased vascularity and heterogeneous echogenicity of the solid component on USG. However, MRI revealed the exact origin of the mass from the uterus. Out of 30 cases, 6 cases were diagnosed as malignant in ultrasound. Out of these six cases, two were serous cystadenocarcinoma, two were mucinous cystadenocarcinoma, one was serous papillary cystadenocarcinoma of the fallopian tube and one was a malignant tubo-ovarian mass. All the six cases were diagnosed the same on MRI and HPE. One case was indeterminate even on MRI. Subsequent histopathological nature of the lesion revealed it to be a broad ligament fibroid with nonvisualization of the normal ovaries due to atrophy in a post-menopausal woman. The nine malignant masses that were correctly diagnosed as malignant on MRI were three cases of serous cystadenocarcinoma, two cases of mucinous cystadenocarcinoma, one case of malignant tubo-ovarian mass, one case of endometrioid carcinoma, one case of serous papillary cystadenocarcinoma of the fallopian tube and two cases of malignant sex cord-stromal neoplasms. Next common benign lesions were serous cystadenomas, mucinous cystadenomas and simple cysts(n=2). Both the two simple cysts were diagnosed correctly on both ultrasound and MRI. The well-defined thin wall and anechoic appearance with posterior acoustic enhancement and absence of internal septations or solid components within on ultrasound and well-defined lesions showing fluid signal intensity on all sequences without any internal septations or solid components helps in the accurate diagnosis of these lesions on both ultrasound and MRI. Both the cases of serous cystadenomas were correctly diagnosed as benign lesions on both ultrasound and MRI. One case of serous cystadenoma was misinterpreted as a simple ovarian cyst on ultrasonography. However, MRI correctly diagnosed it as serous cystadenoma due to the thin internal septations. The other common benign cystic lesion diagnosed was mucinous cystadenoma of ovary (n=2), which were diagnosed by using ultrasound as well as MRI because of its internal echoes and multilocular cystic lesion with fluid of different signal intensity. There were no features of malignancy in both cases. There were two cases of mucinous cystadenocarcinoma, which were accurately diagnosed as malignant on both USG and MRI due to the presence of solid components, mural thickening. One case of the dermoid cyst was correctly diagnosed by both USG and MRI because of its hyperechoic fat content. On fat-sat MRI, the presence of fat was confirmed. One case of pedunculated fibroid with cystic degeneration was misdiagnosed as a solid malignant ovarian lesion on USG due to its large size and solid-cystic appearance. However, MRI could demonstrate the ovaries separately and accurately recognize the organ of origin. Our study reveals that although USG is the first line of investigation for uterine fibroids, it performs poorly in determining the origin of the mass, which is the essential first step in characterizing the pelvic mass. A solid intrauterine

mass is likely to be a fibroid but, a pedunculated fibroid can be located adjacent to the uterus and can mimic an ovarian mass. The large mass size was an additional contributing factor to an indeterminate sonographic diagnosis. Unless specific features of fibroid such as refractory shadowing can be identified, these large solid pelvic masses remain a diagnostic dilemma on USG. The multiplanar imaging capability of MRI allows accurate identification of the origin of adnexal mass lesions[2]. There were five indeterminate cases (16.6%) in this study in which USG could not conclude any specific diagnosis and were termed as indeterminate. There was also confusion regarding the benignity of the lesions. This was similar to a study conducted by Hricak H *et al.* wherein as many as 20% of adnexal lesions were classified as indeterminate by using USG. However, one case which was indeterminate on both USG and MRI and was a dysgerminoma on HPE. In the present study, for characterizing the detected lesions as a malignant lesion, the sensitivity, specificity and accuracy of MRI were 81.80%, 94.7% and 65.7%, respectively and of USG were 36.6%, 94% and 55% respectively. MRI is more sensitive and accurate than USG. In our study, for characterizing the lesions as benign, the sensitivity, specificity and accuracy of MRI were 94.7%, 90.0% and 65%, respectively and of USG were 94.7%, 90.9% and 70% respectively. Our study also shows that high detection rate and accurate characterization of the adnexal lesions are possible using MRI, similar to a study conducted by Sohaib et al. For cases considered suspicious by USG, a more specific diagnosis by MRI may prevent the need for surgery or otherwise change management by identification of benignity. Unenhanced **T1 and T2** weighted imaging are essential for accurate tissue characterization. Lipid and blood products are readily detected on T1 WI with or without fat suppression. T2 WI helps to identify the low signal intensity of fibrous tissue. For a long time laparotomy with excision has been recommended for suspicious adnexal masses. Majority of resected masses are benign. This has prompted consideration of less invasive ways of evaluating these lesions which include USG and MRI, laparoscopy and CA 125 assays. For sonographically indeterminate masses MRI is useful for additional lesion characterization. Analysis of T1-and T2-weighted signal intensities for benign appearing lesions with the addition of fat saturation for high signal on T1W sequences may lead to an exact diagnosis or a narrow differential. For cases considered suspicious by US more specific diagnosis by MRI may obviate the need for surgery or otherwise change management by identification of benign etiology. **The principal features of malignancy on MR** images are familiar from US. These are wall thickening and irregularity, septal thickening and irregularity, or frankly solid components with or without necrosis. In terms of thickening, a measurement of 3 mm has translated from the US morphologic scoring systems into the MR imaging literature. **T2-weighted dark masses** are a common finding after indeterminate US examinations and usually represent either **uterine leiomyomata or ovarian fibromata.** Further assessment should thus help determine if the mass arises from the ovary or uterus. Application of oblique "ovarian axis" may provide the diagnosis by revealing the organ of origin. Further confirmation can be obtained from an additional T2-weighted oblique imaging sequence (section thickness, 3-4mm) perpendicular to the long axis of the uterus or along the plane of suspected connection between the mass and the uterus or ovary. Other causes of high-signal-intensity masses on T1-weighted images include blood products within hemorrhagic masses, including endometriomas or masses that have undergone torsion., mucin and other proteinaceous material within some cystic neoplasms., malignant neoplasms with hemorrhagic change and rarely, melanin within melanoma metastases. All these remain bright on the fat-suppressed T1-weighted images. The most common benign masses within the category of cystic lesions are multilocular benign cysts, complex tubal disease and cystadenofibromata. The most worrying diagnosis is ovarian malignancy, either borderline or frankly invasive primary cancer or metastatic disease, though as these studies emphasize, such masses are the minority. Transvaginal ultrasound along with additional preoperative testing, such as serum cancer antigen 125 (CA-125) levels and the Risk of Ovarian Malignancy Algorithm (ROMA) score, usually provide sufficient information for a presumptive diagnosis. Minimally invasive surgery as a therapeutic approach is the standard procedure for uncomplicated and benign adnexal masses. Histopathological examination alone, or in conjunction with immunohistochemical testing establishes a more certain diagnosis in the final step of the patient management plan. Most of the malignant adnexal lesions demonstrate increased vascularity on color doppler flow imaging. The ability of MRI to manipulate tissue contrast makes this technique an **invaluable tool** in the assessment of complex adnexal masses, helping in characterization of such masses. MRI is more specific and accurate than USG for characterising adnexal masses due to better soft tissue resolution and multiplanar imaging.

CONCLUSION

MRI is also helpful in detecting malignant potential of particular lesion and thus plays a role in oncological staging which to a great extent helps in treatment planning and management. USG is sensitive in picking up lesions and helps as an initial imaging modality for screening of adnexal lesions and is the main triage method before treatment. MRI helps in further evaluation of indeterminate cases and cases with suspicious malignancy which was not diagnosed on USG.

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