Original Research Article

Role of ultrasonography and magnetic resonance imaging in evaluation of adnexal masses

Santosh K Dasar [1], Uthsavi N Patel[2*], Rajeev B Dibbad[3]

[1,3]Associate Professor, Department of Radiodiagnosis, SDM College of Medical Sciences and Hospital, Sattur, Dharwad- 580009 Karnataka, India.
[2]Senior Resident, Department of Radiodiagnosis, Father Muller Chariatable Hospital, Kankanady , Mangalore Karnataka, India.
Email: drsantoshdasar@gmail.com , uthsavipatel@gmail.com, drrajeevdibbad@gmail.com

Abstract

Background: Ultrasonography is the generally the first line investigation in evaluation of suspected adnexal mass as it is widely available, relatively less cost and has high sensitivity. Magnetic resonance imaging helps in characterization of adnexal masses that are not completely evaluated by ultrasound as it can provide additional information on soft tissue composition. **Aim:** To evaluate the role of ultrasonography and magnetic resonance imaging in evaluation of adnexal masses. **Material and Methods:** A total of 40 patients referred to the department of Radio-diagnosis, with clinically suspected adnexal mass, detected with adnexal mass incidentally on ultrasonography or patients with adnexal masses with indeterminate/inconclusive diagnosis on ultrasonography were included. Ultrasonography of pelvis was performed on every patient on Philips HD 11 instrument with curvilinear transducer of 2-5Hz and Transvaginal Ultrasonography was performed with transducer of 4-8 Hz whenever required. Magnetic resonance imaging of pelvis was performed with GE Signa 1.5 Tesla MRI machine. **Results:** Both Ultrasonography and Magnetic Resonance Imaging correctly diagnosed 22 cases (55%) as benign and 6 cases (15%) as malignant. MRI correctly diagnosed 2 cases (5%) with benign lesion, which were thought to be malignant on ultrasonography and also correctly diagnosed 3 cases (7.5%) with malignant lesion which on ultrasonography were thought to be benign. Both USG and MRI incorrectly diagnosed 1 case (2.5%) as benign. Among 6 indeterminate cases (15%), 5 cases were correctly diagnosed by MRI, whereas MRI could not give a conclusive diagnosis in one case (2.5%). **Conclusion:** MRI was proved to be better than USG in characterising the adnexal lesions as benign or malignant because of its higher soft tissue resolution and multiplanar imaging. MRI has better accuracy and specificity in recognising the malignant potential of the lesion which are 95% and 96.6% respectively.

Keywords: Adnexal masses, ultrasonography, magnetic resonance imaging, sensitivity, specificity, accuracy

[*]**Address for Correspondence:**
Dr Uthsavi N Patel, Senior Resident, Department of Radiodiagnosis, Father Muller Chariatable Hospital, Kankanady , Mangalore, Karnataka, India.
Email: uthsavipatel@gmail.com

Received Date: 14/11/2019 Revised Date: 09/12/2019 Accepted Date: 11/01/2020
DOI: https://doi.org/10.26611/101313216

Access this article online	
Quick Response Code:	Website: www.medpulse.in
	Accessed Date: 14 February 2020

INTRODUCTION

The primary aim of imaging in the evaluation of an adnexal mass is to differentiate malignant and benign diseases so as to plan the appropriate treatment protocol.[1] Since there is considerable difference between these types of surgery, it is important 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 to 10%, of which less than 25% prove to be malignant. The benign or malignant nature of an adnexal mass 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,

How to cite this article: Santosh K Dasar, Uthsavi N Patel, Rajeev B Dibbad. Role of ultrasonography and magnetic resonance imaging in evaluation of adnexal masses. *MedPulse – International Journal of Radiology.* February 2020; 13(2): 93-97.
http://www.medpulse.in/Radio%20Diagnosis/

necessary preoperative planning and counselling of the patient.[2] Ultrasonography is the generally the first line investigation in evaluation of suspected adnexal mass as it is widely available, relatively less cost and has high sensitivity.[2] Magnetic resonance imaging helps in characterization of adnexal masses that are not completely evaluated by ultrasound as it can provide additional information on soft tissue composition of adnexal masses based on specific tissue relaxation times. It also allows multiplanar imaging to define the origin and extent of pelvic pathology. The present study was conducted to evaluate the role of ultrasonography and magnetic resonance imaging in evaluation of adnexal masses.

MATERIAL AND METHODS

Study population

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

Study design: A cross sectional / prospective study

Inclusion criteria

1. Clinically suspected cases of adnexal mass lesions.
2. Adnexal mass lesions found incidentally on ultrasonography.
3. Adnexal masses with indeterminate / inconclusive diagnosis on ultrasonography.

Exclusion criteria

1. All midline uterine mass lesions
2. Clinically and sonologically proved cases of ectopic pregnancy.
3. All Patients having cardiac pacemakers, prosthetic heart valves, cochlear implants or any metallic implants.

Sample size

Based on the figures available on the sensitivity of Ultrasonography and Magnetic Resonance Imaging in the literature[3] and with 95% confidence and 20% precision, the estimated sample size was 40 patients and our study included 40 patients.

Sampling procedure

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.

Data collection

A detailed clinical history and a written informed consent were obtained from the patients. Ultrasonography of pelvis was performed on every patient on Philips HD 11 instrument with curvilinear transducer of 2-5Hz and Transvaginal Ultrasonography was performed with transducer of 4-8 Hz whenever required. Magnetic resonance imaging of pelvis was performed with GE Signa 1.5 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

1. Axial T1weighted spin echo sequence utilized a TR of 900 ms, TE 18 ms, field of view (FOV) 37 cm, slice thickness 6mm, spacing 1.5-2.0 mm, NEX 3.0, 512X256 matrix.
2. Axial T2 weighted fast spin echo sequence utilised 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.
3. 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.
4. 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.
5. Fat suppressed spoiled gradient echo T1weighted images before and after contrast administration were obtained in axial, sagittal and coronal planes by utilising a TR 1080, TE 18, FOV 37, slice thickness 6.0-7.0 mm, spacing 1.5-2.0 mm, NEX 1.00, 256x160 matrix.

Statistical analysis

The USG and MRI characterization of the subjects was compared with the final diagnosis. Data were analysed using a student t test/ z test. Descriptive statistical values including sensitivity, specificity, positive and negative predictive values and accuracy were determined.

RESULTS

This study comprised of females between 18 to 66 years with mean age of 40.85 years. Benign lesions were found mainly in the age group of 21-30 years, whereas malignant lesions were found mainly in the age group of 50-70 years. In the present study more number of benign lesions 30 of 40 cases (75%) were detected than malignant lesions 10 of 40 cases (25%).

Table 1: USG diagnosis

USG diagnosis	Number (40)	%
Serous cystadenoma	7	17.5
Mucinous cystadenoma	4	10
Serous cystadenocarcinoma	2	5
Mucinous cystadenocarcioma	1	2.5
Solid benign ovarian tumors	2	5

Other carciomas	5	12.5
Dermoid	2	5
Pedunculated/subserosal fibroid	1	2.5
Hemorrhagic cyst	1	2.5
Peritoneal inclusion cyst	1	2.5
Hydrosalphinx	1	2.5
Tubo-ovarian abscess	1	2.5
Ovarian torsion	2	5
Simple ovarian cyst	3	7.5
Endometriosis	1	2.5
Indeterminate	6	15

Table 2: MRI Diagnosis

MRI diagnosis	Number (40)	%
Serous cystadenoma	6	15
Mucinous cystadenoma	3	7.5
Serous cystadenocarcinoma	4	10
Mucinous cystadenocarcioma	2	5
Solid benign ovarian tumors	2	5
Other carciomas	3	7.5
Dermoid	3	7.5
Pedunculated/subserosal fibroid	3	7.5
Hemorrhagic cyst	2	5
Peritoneal inclusion cyst	1	2.5
Hydrosalphinx	1	2.5
Tubo-ovarian abscess	1	2.5
Ovarian torsion	2	5
Simple ovarian cyst	3	7.5
Endometriosis	3	7.5
Indeterminate	1	2.5

Out of all the benign lesions, most common lesion was serous cystadenoma of ovary (n=6) out of which 5 were easily diagnosed by both ultrasound and MRI. One case of serous cystadenoma was misinterpreted as simple ovarian cyst on ultrasonography. However, MRI correctly diagnosed it as serous cystadenoma due to the presence of thin septations. Next common benign cystic lesion diagnosed was mucinous cystadenoma of ovary (n=3) which were diagnosed by using ultrasound as well as MRI because of its internal echoes and T1 hyper intensity. Two cases of serous cystadenocarcinoma and one case of mucinous cystadenocarcinoma were wrongly diagnosed as benign serous cystadenoma and mucinous cystadenoma respectively on USG. However, on MRI, the lesions were categorised as malignancy due to the presence of thick walls, septations and papillary projections. In 30 cases (75%), both USG and MRI gave same diagnosis. However, there was discrepancies in the characterization of the lesions in 10 (25%) cases.

Table 3: USG for benign lesions

	Benign		
	Disease present	Disease absent	
Positive	27	4	31
Negative	3	6	9
Total	30	10	40

Table 4: USG for Malignant lesions

	Malignant		
	Disease present	Disease absent	
Positive	6	3	9
Negative	4	27	31
Total	10	30	40

Table 5: Sensitivity and specificity of ultrasonography

USG diagnosis	Benign	Malignant
Sensitivity %	90.0	60
Specificity %	60.0	90
PPV %	87.0	66.6
NPV %	66.6	87.0
Accuracy %	82.5	82.5

There are two cases of hemorrhagic cysts in this study out of which one was diagnosed correctly on USG by recognition of reticular pattern and fibrin strands within the cyst. MRI was required to diagnose another case which had a complex appearance on USG. Two cases of ovarian torsion were correctly diagnosed by both Ultrasonography and MRI and confirmed with operative findings. Three cases of simple ovarian cysts were accurately diagnosed by both Ultrasonography and MRI and confirmed with follow up study.

Table 6: MRI for benign lesions

	Benign		
	Disease present	Disease absent	
Positive	29	1	30
Negative	1	9	10
Total	30	10	40

Table 7: MRI for malignant lesions

	Malignant		
	Disease present	Disease absent	
Positive	9	1	10
Negative	1	29	30
Total	10	30	40

Table 8: Sensitivity and specificity of magnetic resonance imaging

MRI diagnosis	Benign	Malignant
Sensitivity %	96.6	90.0
Specificity %	90.0	96.6
PPV %	96.0	90.0
NPV %	90.0	96.0
Accuracy %	95.0	95

USG diagnosed two cases of solid malignant lesions of the ovaries which correlated with similar features on MRI. USG also diagnosed another solid and cystic malignant ovarian mass. However, MRI was more accurate in determining the origin of the lesion as tubo-ovarian malignant mass. USG wrongly diagnosed two cases of complex solid and cystic lesions as malignant. However, MRI accurately diagnosed one of them as dermoid cyst by

demonstrating the solid component as fat, which appeared hyperintense on T1W and was suppressed on T1FAT SAT images. MRI could also correctly diagnose another case of complex lesion as endometrioma by demonstrating the solid component as blood clot which appeared hyperintense on T1W, T1FAT SAT images and hypointense on T2W images. Both the cases displayed no enhancing solid tissue on MRI. USG diagnosed a case of solid benign lesion of the ovary which correlated with similar features on MRI. A case of malignant germ cell tumour/dysgerminoma was misdiagnosed as benign solid ovarian tumour on both USG and MRI because of its small size, well defined margins, and homogenous echotecture. The lesion appeared hypointense on T2W images and showed enhancement on post contrast study. Two cases of dermoid cyst were diagnosed correctly by both USG and MRI because of its hyper echoic fat content. On fat-sat MRI, presence of fat was confirmed. There are three cases of endometriomas in this study, out of which only one was diagnosed correctly on USG by recognition of fluid-fluid levels within the cyst. MRI was required in other two cases to accurately characterize the lesion. One case of tubo-ovarian abscess and another case of peritoneal inclusion cyst was recognised on both USG and MRI and its benign nature was identified with no obvious difficulty. One case of hydrosalphinx was accurately diagnosed on USG because of its tubular shape and incomplete septations which correlated with MRI findings.

DISCUSSION

The goal of imaging in the evaluation of an adnexal mass is to differentiate malignant and benign masses in order to plan appropriate treatment algorithm required.[1] Ultrasonography (USG) is an established method to detect and characterize a suspected adnexal mass. It is an important 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] 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 largely on imaging appearance.[5] In the present study more number of benign lesions 30 of 40 cases (75%) were detected than malignant lesions 10 of 40 cases (25%) , which is in concordance with the study conducted by Sohaib *et al*. where 43 (60%) had benign lesions and 29 (40%) had malignant masses. Three cases of subserosal/pedunculated fibroids are present in this study, out of which only one case was diagnosed by USG and confirmed by MRI. 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. Another case of pedunculated fibroid was misdiagnosed as benign solid ovarian tumour on USG. However in both the cases MRI could demonstrate the ovaries separately and accurately recognise the organ of origin. This is in concordance with the study conducted by Adusumilli S *et al*.[1] where in Ultrasonography had poor agreement in determining the origin of 17 0f 20 uterine cases in which MRI was the problem-solving tool in recognising organ of origin. MRI could also characterize both the lesions accurately because of its hypointense signal intensity on T2W image. The multiplanar imaging capability of MRI allows accurate identification of the origin of adnexal mass lesions.[2] There were 6 indeterminate cases (15%) 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 study conducted by Hricak H *et al.*[6] where in as many as 20% of adnexal lesions were classified as indeterminate by using USG. Spencer *et al.*[7] has suggested that a sonographically indeterminate adnexal mass as (a) one that is complex and cannot be confidently placed into either the benign or malignant category or (b) or the one whose site of origin (ovary, uterus, or another pelvic structure) remains to be established. Of the six indeterminate cases, MRI could accurately diagnose 5 cases which correlated with histopathology findings. One was diagnosed as endometrioma, one as pedunculated fibroid with cystic degeneration, one as hemorrhagic cyst, one as pedunculated fibroid and one as serous cystadenoma. However one case which was indeterminate on both USG and MRI was a large broad ligament fibroid which was diagnosed as solid benign ovarian tumour in a post-menopausal woman because neither ovary were identified. In the present study, for characterizing the detected lesions as a malignant lesion, the sensitivity, specificity and accuracy of MRI were 90.0%, 96.6% and 95% respectively and of USG were 60.0%, 90.0% and 82.5% respectively. MRI is more specific than USG. This is similar to study conducted by Sohaib *et al.* where in the specificity for malignant lesions of MRI and USG were 83.7% and 39.5% respectively.[4] In our study, for characterizing the lesions as benign the sensitivity, specificity and accuracy of MRI were 96.6%, 90.0% and 95% respectively and of USG were 90.0%, 60.0% and 82.5% respectively. Excellent agreement was seen between MR findings and the final diagnosis in the aspect of origin, tissue content and tissue characteristics of the masses. Sonography had relatively poor correlation in context to the final diagnosis for the origin and tissue content of a mass. The main reasons for indeterminate sonographic diagnoses were inability to determine origin because of location, large size of the mass and the purely solid or complex cystic appearances of

masses.[1] In our study, MRI has shown to be more specific and accurate than ultrasonography for characterizing adnexal masses as it provides excellent contrast resolution, resulting in accurate tissue characterization and improved anatomic delineation. This is similar to study conducted by Allen *et al.*[8] where MRI was more specific and accurate than Ultrasonography. Our study confirms the high detection rate and accurate characterization of the adnexal lesions that are possible using MRI, which is similar to a study conducted by Sohaib *et al*.[4]

CONCLUSION

MRI was proved to be better than USG in characterising the adnexal lesions as benign or malignant because of its higher soft tissue resolution and multiplanar imaging. MRI has better accuracy and specificity in recognising the malignant potential of the lesion which are 95% and 96.6% respectively.

REFERENCES

1. Adusumilli S, Hussain HK, Caoili EM, *et al.*. MRI of sonographically indeterminate adnexal masses. AJR Am J Roentgenol 2006;187(3):732-740 .
2. Sohaib SAA, Sahdev A, Van Trappen P, Jacobs IJ, Reznek RH. Characterization of adnexal lesions on MR imaging. AJR 2003;180:1297-1304.
3. Ash Saini, Robert Diana, *et al.*. Characterization of adnexal masses with MRI. AJR 2005; 184(3):1004-1009.
4. Sohaib SA, Mills TD, Sahdev A, *et al.*. The role of magnetic resonance imaging and ultrasound in patients with adnexal masses. Clin Radiol 2005; 60(3):340–348.
5. Jeong YY, Outwater EK, Kang HK. Imaging evaluation of ovarian masses. Radio Graphics 2000;20:1445-1470.
6. Hricak H, Chen M, Coakley FV, *et al.*. Complex adnexal masses: detection and characterization with MR imaging-multivariate analysis. Radiology 2000;214:39-46.
7. Spencer JA, Ghattamaneni S. MR Imaging of the Sonographically Indeterminate Adnexal Mass. Radiology 2010; 256(3):677-694.
8. Allen BC, Keyanoosh, Shadi A, *et al.*. Practical approach to MRI of Female Pelvic Masses. AJR 2014; 202:1366–1375.

Source of Support: None Declared
Conflict of Interest: None Declared