

Comparative study of diagnostic efficacy of ultrasound and MRI in the evaluation of adnexal mass lesions in relation of Histopathological outcomes.

¹Dr. Hema Ram Kalbi, PG student, Dept of Radiodiagnosis. Dr SN Medical College, Jodhpur.

²Dr. Ramanand Gehlot, Sr Professor and Head, Dept of Radiodiagnosis. Dr SN Medical College, Jodhpur.

³Dr. Kirti Chaturvedy, Sr Professor, Dept of Radiodiagnosis, Dr SN Medical College, jodhpur.

⁴Dr. Rajendra Chaudhary, AP Dept of Radiodiagnosis, Dr SN Medical College, Jodhpur.

⁵Dr. Mohammed Arshad, PG Student, Dr SN Medical College, Jodhpur.

⁶Dr. Sarthak Batra, PG student, Dr SN Medical College, Jodhpur.

⁷Dr. Abhishek Garg, PG student, Dr SN Medical College, Jodhpur.

⁸Dr. Sonali Barad, PG student, Dr SN Medical College, Jodhpur.

Corresponding Author: Dr. Hema Ram Kalbi, PG student, Dept of Radiodiagnosis. Dr SN Medical College, Jodhpur.

Citation this Article: Dr. Hema Ram Kalbi, Dr. Ramanand Gehlot, Dr. Kirti Chaturvedy, Dr. Rajendra Chaudhary, Dr. Mohammed Arshad, Dr. Sarthak Batra, Dr. Abhishek Garg, Dr. Sonali Barad, “Comparative study of diagnostic efficacy of ultrasound and MRI in the evaluation of adnexal mass lesions in relation of Histopathological outcomes”, IJMSIR- June - 2023, Vol – 8, Issue - 3, P. No. 116 – 123.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Introduction

The lesions of adnexal origin constitute one of the leading causes of female morbidity, a less common cause of mortality and a frequent reason for gynecologic surgery. The prevalence of adnexal lesions in the general population is 0.17%–5.9% in asymptomatic women and 7.1%–12% in symptomatic women.

Majority of adnexal lesions are ovarian in origin, some involving both ovaries and fallopian tubes and some are uterine in origin and very few lesions arise from fallopian tube *per se*. Rarely the lesions can arise from ligaments supporting these organs.

The main challenge to the radiologist is to differentiate benign from malignant adnexal lesions in order to direct patients to the appropriate treatment algorithm. Determining whether a clinically diagnosed adnexal lesion is

benign or malignant is frequently not possible until surgical exploration and histologic examination are performed.

Ultra sono graphy is the most practical modality for assessment of ovarian tumors because it is readily available and has a high negative predictive value.

Sonography is indisputably the primary imaging modality, because of its widespread availability, relatively low cost, and high sensitivity in the detection of masses. However, sonography is limited by its decreased specificity for the diagnosis of benignity, which can vary from 60% to 95% and result in as many as 20% of adnexal masses being classified as indeterminate.

CT is less effective than US and MRI for characterization of an ovarian mass due to its limitation of relative lack of soft tissue discrimination.

Since magnetic resonance imaging (MRI) offers high contrast resolution, provides good tissue characterization, and is capable of multiplanar imaging capabilities, it has become an invaluable tool for the evaluation of female pelvic pathology. With the advantages of superb tissue contrast resolution and no ionizing radiation, magnetic resonance imaging (MRI) is generally performed for problem solving in the assessment of indeterminate sonographic adnexal masses.

Since MRI is more expensive and potentially less readily available than ultrasound, it is important to know when patients should undergo MRI. Follows a brief overview of the situations in which MRI should be considered to evaluate the female pelvis.

1 MRI should be considered for the evaluation of adnexal pathology when sonographic characteristics are not definitive to determine whether an adnexal mass is ovarian in origin and to determine the likelihood of malignancy.

2 If a cystic adnexal mass >5 cm in a premenopausal woman or >3 cm in a postmenopausal woman persists or increases in size on follow-up ultrasound, MRI should be considered so that malignancy can be excluded.

3 MRI should also be considered when a solid or solid cystic adnexal lesion with internal color flow is detected by ultrasound.

4 A simple unilocular ovarian cyst is not an indication for MRI, as it is a common incidental finding in both pre- and postmenopausal women.

5 Most hemorrhagic ovarian cysts may be accurately diagnosed by ultrasound. MRI, however, should be considered when the hemorrhagic cystic lesion persists or increases in size on follow-up ultrasound.

6 MRI can identify lesions obscured at laparoscopy by dense adhesions.

7 In a suspected case of ovarian torsion, MRI can be performed if sonographic results are equivocal.

Our study is aimed to analyse and compare the diagnostic efficacy of ultrasonography and MR imaging features in the detection, characterization of adnexal mass lesions and differentiation of benign and malignant mass.

Methodology

The study was conducted in the department of Radio-diagnosis, Dr S.N. medical college, Jodhpur, and associated group of hospitals. The subjects of this studied had been patients who were clinically suspected to had adnexal lesions.

The studied had been performed on all patients after written informed consent. USG and MRI were performed in all patient with adnexal lesions

Inclusion criteria

- Age specification (> 14 years)
- Clinically suspected (pain abdomen, lower abdominal lump, difficulty in micturition/ urinary retention and bleeding in post-menopausal women) cases of adnexal mass lesions
- Adnexal mass lesions had been observed on ultrasound.

Exclusion criteria

- All uterine mass lesions.
- Sonographic ally 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 in situ.
- Contraindication (absolute or relative) of contrast agent.
- Pregnant female
- Left out patients.

USG imaging

The imaging features documentation would include the number of adnexal masses per patient, origin of lesion (ovarian, uterine, tubal, tubo-ovarian or extraovarian), lesion shape, lesion size, and content of lesion (solid only, complex solid-cystic, and cystic only). If a wall and internal septae could be identified, its thickness, character, and enhancement had been noted. If septa were present in the lesion, the number, thickness, character (smooth or irregular), and of lesions had been recorded. Any vegetation appearing on the wall or the septum of the lesion had been measured and noted

MR Imaging Techniques

MR imaging had been performed on a 1.5-T MR imaging unit. Patients were kept fasting for at least 3-4 hours prior to examination. The following sequences were obtained:

- Axial T1-weighted spin-echo
- Axial T2-weighted fast spin-echo
- Sagittal T2-weighted fast spin-echo
- Enhanced fat-suppressed spoiled gradient-echo T1-weighted
- Contrast-enhanced images were obtained after intravenous injection of 0.1 mmol/kg of gadopentetate Di meglumine.

MR Image Analysis

The MR images were evaluated without knowledge of the surgical or pathologic findings. The MR imaging features were correlated with the surgical and pathologic findings. The imaging features documentation included the number of adnexal masses per patient, origin of lesion (ovarian, uterine, tubal, tubo-ovarian or extra-ovarian), lesion shape, lesion size, and content of lesion (solid only, complex solid-cystic, and cystic only). If a wall and internal septae could be identified, its thickness, character, and enhancement was noted. If septa were present in the lesion, the number, thickness,

character (smooth or irregular), and enhancement of the septa had been recorded. Any vegetation appearing on the wall or the septum of the lesion was measured and noted. Tissue with low signal intensity on T2-weighted MR images (i. e., \leq signal intensity of skeletal muscle) was also noted. Such low-signal-intensity tissue was indicative of fibrous tissue, which was found in benign ovarian tumors. Patients who were not operated or lost to follow-up; the imaging features were described.

Histopathological findings

The histopathological findings were noted. The features documentation would include the content of lesion (solid only, complex solid-cystic, and cystic only). If a wall and internal septae could be identified, its thickness, and character was noted. If septa were present in the lesion, the number, thickness, character (smooth or irregular), and of lesions had been recorded. Any vegetation appearing on the wall or the septum of the lesion had been measured and noted. The findings on USG and MRI were compared with histopathological findings.

Result

A total of 40 female patients with clinically suspected adnexal lesions underwent USG and MRI scan and were analysed for adnexal lesions and followed up wherever possible.

The most common age group encountered in 40 patients was 30-50 years and total 19 lesions (47.5 %). The next common age group encountered was ≤ 30 years and total 12 lesions (30 %). The next common age group encountered was 51-60 years and total 5 lesions (12.5 %). The next common age group encountered was ≥ 61 years and total 4 lesions (10 %).

Analysis of 40 patients with adnexal lesion on MRI and ultrasound had revealed that 33 patients (82.5 %) had unilateral lesions and 7 patients (17.5 %) had bilateral

adnexal lesions. Out of 33 unilateral adnexal mass lesions 29 were benign and 4 were malignant. Out of 7 bilateral adnexal mass lesions 2 were benign and 5 were malignant.

Comparative analysis of USG and MRI findings

On ultrasound 29 (72.50%) lesions were reported as benign and 11(27.50%) lesions were reported as malignant whereas on MRI 30 (75%) lesions were given as benign and 10 (25%) as malignant lesions. On histopathology 31 were benign and 9 were malignant.

Four lesions on USG were diagnosed as malignant but proved to be benign on histopathology and two lesions on USG were diagnosed as benign, proved to be malignant on histopathology.

In our study, the sensitivity, specificity and accuracy of USG in diagnosing malignancy were 77.78%, 87.10% and 85% respectively.

One lesion on MRI was diagnosed as malignant but proved to be benign on histopathology.

The sensitivity, specificity and accuracy of MRI in diagnosing malignancy were 100%, 96.7% and 97.5% respectively

Table 1: Sensitivity, specificity, PPV, NPV and diagnostic accuracy of USG in diagnosing malignant adnexal lesions in 40 patients with adnexal lesions.

USG findings	HPE				Total	
	Malignant		Benign			
	N	%	N	%	N	%
Malignant	7	77.78	4	12.90	11	27.50
Benign	2	22.22	27	87.10	29	72.50
Total	9	100.00	31	100.00	40	100.00

P value 0.0005 (S)

Sensitivity (TP/TP+FN) X100 - 77.78%
 Specificity (TN/TN+FP) X100 - 87.10%
 PPV (TP/TP+FP) X100 - 63.64%
 NPV (TN/TN+FN) X100 - 93.10%

Diagnostic accuracy (TP+TN/ TP+FP+ TN+FN) X100 - 85%

Table 2: Sensitivity, specificity, PPV, NPV and diagnostic accuracy of MRI in diagnosing malignant adnexal lesions in 40 patients with adnexal lesions.

MRI findings	HPE				Total	
	Malignant		Benign			
	N	%	N	%	N	%
Malignant	9	100.00	1	3.23	10	25.00
Benign	0	0.00	30	96.77	30	75.00
Total	9	100.00	31	100.00	40	100.00

P value <0.0001 (S)

Sensitivity (TP/TP+FN) X100 - 100%
 Specificity (TN/TN+FP) X100 - 96.77%
 PPV (TP/TP+FP) X100 - 90%
 NPV (TN/TN+FN) X100 - 100%
 Diagnostic accuracy (TP+TN/ TP+FP+ TN+FN) X100 - 97.5%

Table 3: histopathological characteristic of adnexal lesions in patients

Histopathological findings	No. of patients	Percentage
Brenner Tumor	1	2.50
Cystic adenofibroma	1	2.50
Dermoid cyst	6	15.00
Enlarged hemorrhagic corpus luteal cyst.	3	7.50
Fibro thecoma	1	2.50
Metastatic adenocarcinoma	2	5.00
Mucinous cystadenoma	4	10.00
Mucinous cystadenocarcinoma.	2	5.00
Serous cystadenocarcinoma	4	10.00

Serous cyst adenofibroma	3	7.50
Serous cystadenoma	10	25.00
Tubo-ovarian Abscess	2	5.00
Well differentiated Sertoli Leydig Cell tumor	1	2.50
Total	40	100.00

Discussion

The major aim of the present study was to compare the diagnostic efficacy of USG and MRI for detection and characterization of adnexal lesions.

Adnexal lesions with benign nature were commonly seen in women of reproductive age group whereas malignant lesions and malignancy risk increases in older age groups.

In our study, abdominal pain (80%) followed by abdominal distension (66%) and bleeding per vaginum (62%) were most common clinical presentations. Dysuria and constipation were seen in few patients with large masses mainly due to pressure effect. Some patients were asymptomatic and adnexal lesions diagnosed incidentally these observations are in concordance with study done by Anand Dipak Bhagde et al (2017)⁴

In present study, the size of 40 adnexal lesions in total 40 patients were analysed on MRI. Out of total 30 benign lesions, 10 lesions (33.4%) were < 4 cm in size and 20 lesions (66.6%) were >4 cm in size. Out of total 10 malignant lesions, only 3 lesions (30%) were <4cm in size and 7 lesions (70%) were >4cm in size.

These findings were similar to study performed by A. L. Valentini et al (2012)³ and Amit Nandan Dhar Dwivedi et al (2013)⁽²⁾.

In this study, total 40 patients were analysed on MRI for type of contents (solid/complex solid-cystic/cystic). Out of 10 malignant adnexal lesions, 6 lesions (60%) were solid, 2 (20%) were solid – cystic. One (10%) adnexal malignant lesion was cystic with thick irregular wall and

septae (serous cystadenocarcinoma). These findings were similar to study performed by A. L. Valentini et al (2012)⁽³⁾.

Analysis of various features of benign and malignant lesions in 40 patients with adnexal lesions on USG

In this study, total 40 patients with adnexal lesions were analysed on USG. Out of 40 adnexal lesions, 11 (27.5%) were diagnosed as malignant while 29 (72.5%) cases were diagnosed as benign.

Out of total 40 patients 33 (82.5%) shows unilateral lesions - 5 (12.5 %) malignant and 28 (70%) benign and 7 shows bilateral adnexal lesions - 6 (15%) malignant and 1 (2.5%) benign.

In this study, total 40 patients were analysed on MRI for type of contents (solid/complex solid-cystic/cystic). Out of 11 malignant adnexal lesions, 6 lesions (54.5%) were solid, 3(27.2%) were solid – cystic. Two (18.18%) adnexal malignant lesion was cystic with thick irregular wall and septae. These findings were similar to study performed by A. L. Valentini et al (2012)⁽³⁾.

Comparative analysis of USG and MRI findings with histopathological findings in 40 patients.

In this study, 40 adnexal lesions (n=40 adnexal lesions) were analysed by USG and MRI and compared on histopathology.

The sensitivity, specificity, PPV, NPV and diagnostic accuracy of USG in diagnosing malignant adnexal lesions in 40 patients were 77.78%, 87.10%, 63.64%, 93.10% and 85% respectively. On USG evaluation out of 9 malignant lesions 7 were diagnosed as malignant correctly and two were diagnosed as benign. Out of 31 benign lesions 27 were diagnosed benign correctly and 4 lesions were diagnosed as malignant.

The sensitivity, specificity, PPV, NPV and diagnostic accuracy of MRI in diagnosing malignant adnexal lesions in 40 patients were 100%, 96.77%, 90%, 100% and

97.5% respectively. On MRI evaluation all malignant lesion were diagnosed correctly and one benign lesion was diagnosed malignant.

Description of various adnexal lesions seen in this study

Analysis of 40 patients with adnexal lesions on MRI, there were total 40 lesions and 13 types of lesions were detected. Most common benign lesions were serous cystadenoma (25%), followed by dermoid cyst (15%), mucinous cystadenoma (10%), serous cyst adenofibroma (10%), hemorrhagic ovarian cyst (7.5%), infective tubo ovarian masses (5%) and fibro thecoma (2.5%). Most common malignant adnexal lesion were serous cystadenocarcinoma (10%) followed by mucinous cystadenocarcinoma (5%), metastatic adenocarcinoma (5%) and one case (2.5%) was diagnosed as well differentiated sertoli- Leydig cell tumour. Out of two metastatic adenocarcinoma one lesion was Krukenberg tumour (2.5%) with malignant thickening seen in descending and sigmoid colon.

The adnexal lesions encountered in present study were as following

Serous Cystadenoma

There were 10 patient of serous cystadenoma. One of them had bilateral. On USG and MRI, all serous cystadenoma were diagnosed as well defined, cystic lesions thin and smooth wall with or without septae. These findings of benignity were similar to study done by Valentini AL et al (2012)³, Jeong YY et al (2000)⁴, Funt SA et al (2002)⁵ and Byun JY (2006)⁶.

Mucinous Cystadenoma

There were 4 patients of mucinous cystadenoma. All cases of mucinous cystadenomas were unilateral. On USG and MRI, all mucinous cystadenoma were diagnosed as well defined, cystic lesions thin and smooth wall with or without septae. On USG 3 of them were

diagnosed as benign and one of them was diagnosed as malignant. On MRI all lesions were diagnosed correctly as benign lesions. These findings of benignity were similar to study done by Valentini AL et al (2012)⁽³⁾

Serous cyst adenofibroma

There were 4 patients of serous cyst adenofibroma. All cases of serous cyst adenofibroma were unilateral. On USG and MRI, all mucinous cystadenoma were diagnosed as well defined, cystic lesions thin and smooth wall with or without septae. On USG and MRI all lesions were diagnosed correctly as benign lesions.

Hemorrhagic ovarian cysts

There was 3 patient of hemorrhage cyst. On USG and MRI these lesions were diagnosed as well-defined cystic lesions with fine internal echoes, reticulations, and blooming on GRE sequences. USG as well as MRI diagnosed all these lesions as benign cystic lesions correctly.

Dermoid cysts

In our study, there were 6 patients of dermoid cyst. On USG, 6 of them were complex solid cystic mass with internal hyperechoic content shows posterior acoustic shadowing. On MRI, these were complex cystic masses with areas of T1W/T2W hyperintense signals with corresponding loss signals on fat suppressed sequences. All 6 patients had unilateral lesions. The sensitivity of USG and MRI was 100% in diagnosing dermoid cysts. These findings were similar to study done by Out water EK et al (2001)⁷.

Infective Tubo-ovarian masses

There were 2 patients of infective tubo-ovarian masses. On USG were seen as thick walled heteroechoic cystic and tubular fluid filled lesions with internal septations in adnexal region. 1 of them was seen mixed hypoechoic mass in adnexal region and diagnosed as malignant lesion on MRI. On MRI, all were seen as cystic and

tubular structures in adnexal region with T2W hyperintense fluid signals and T1W hypointense signals with central diffusion restriction. On MRI both of lesions diagnosed as benign lesion. These findings were similar to study done by Kim MY et al (2009)⁸.

Brenner's tumour

There was 1 patient of Brenner's tumour. On USG seen as large heteroechoic solid cystic adnexal lesion showing internal vascularity. On MRI Predominantly solid cystic abdomino-pelvic adnexal lesion with multiple enhancing septations and enhancing solid component. The lesion was diagnosed as malignant lesion on both US and MRI but on HPE it was benign in nature.

Fibro thecoma

There was 1 patient of fibro thecoma which appeared large heteroechoic solid adnexal lesion on USG and corresponding MRI findings were large well-defined hypointense lesion on T1/T2 WI with progressive post contrast homogenous enhancement.

Serous Cystadenocarcinoma

There were 4 patients of Cystadenocarcinoma. On USG, these were large solid cystic / cystic masses with thick and irregular wall and multiple thick and irregular septae. Multiple mural nodules were also seen as solid component. On MRI, these were cystic masses with thick and irregular wall and thick and multiple irregular septae. Out of 4 serous cystadenocarcinoma 3 were unilateral and 1 was bilateral. On USG 3 were correctly diagnosed as malignant while 1 was diagnosed as benign lesion. On MRI all 4 lesions were diagnosed as malignant correctly. These findings were similar to Valentini AL et al (2012)³ and Guerra A et al (2008)⁹

Mucinous cystadenocarcinoma

There were 2 patients of Mucinous cystadenocarcinoma which appeared solid cystic / cystic masses with variable echogenicity, thickened irregular wall, multiple thick and

irregular septae showing internal vascularity on USG, large amount of ascites was also seen. Multiple mural nodules were also seen as solid component. On MRI, these were cystic masses with thick, irregular wall, thick and multiple irregular septae. Each patient shows bilateral adnexal lesions. On USG and MRI both lesions were correctly diagnosed as malignant lesions. These findings were similar to Valentini AL et al (2012)³ and Guerra A et al (2008)⁹

Krukenberg Tumour

There was 1 case of histopathologic ally proven Krukenberg Tumour in bilateral ovary. On USG, there was complex solid cystic mass showing vascularity on color mode and enlarged left ovary noted. On MRI, the bilateral adnexal lesion was hypointense T1W images and mixed hyperintense on T2W images with moderate postcontrast enhancement of solid component of right adnexal region and left ovary.

Sertoli-Leydig cell tumour

There was 1 case of sertoli-Leydig cell tumour. On USG, Large cystic adnexal lesion with eccentric solid component and internal vascularity. On MRI, Large well-defined unilocular cystic lesion with enhancing papillary projection. No omental or peritoneal nodularity.

Conclusion

In USG, 27.5% of patients were malignant ovarian tumours, whereas 72.5% involved benign lesions. MRI results revealed that 75% of individuals had benign lesions and 25% of cases had malignant ovarian lesions. According to histopathological analysis of post-operative samples, 77.5% of cases had benign ovarian lesions and 22.5% of cases had malignant ovarian lesions. The comparison of USG and HPE results shows an 93.1% negative predictive value, 63.6% positive predictive value, 77.7% sensitivity, and 85% diagnostic accuracy. When compared to MRI results, HPE has a 100%

sensitivity, 96.7% specificity, 90% positive predictive value, 100% negative predictive value, and 97.5% diagnostic accuracy. According to the findings, MRI was more accurate and sensitive than USG. MRI is more commonly used to diagnose and characterize adnexal mass lesions than.

Since MRI offers superior specificity, a lower false-positive rate, and a higher sensitivity in detecting invasion of neighboring organs and organs of origin of lesions, it may be thought of as a complementary test for the best patient care. The referring doctor and the radiologist can work together quickly to settle cases with pelvic masses. The right accessible examinations must be chosen in order to determine the diagnosis with the greatest care and accuracy in the shortest amount of time possible, hence cutting down on the number of tests needed and the amount of time needed to establish a diagnosis. The primary diagnostic imaging method used before therapy is still ultrasound. A decrease in false-positive results and invasive procedures is made possible by improved pelvic mass detection and characterization, which also improves diagnostic accuracy.

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