ORIGINAL RESEARCH ARTICLE

Comparative Study of Ultrasonography and Magnetic Resonance Imaging in the Diagnosis of Adnexal Lesions

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A B S T R A C T

Introuction: Adnexal lesions are common disorders in gynaecology. Determining the nature of the adnexal lesion whether benign or malignant needs to be ascertained, to ensure that the patient gets appropriate treatment for the condition. Study aimed to evaluate the accuracy of ultrasonography in detection and characterization of adnexal lesions in comparison with MRI

Material and methods: This cross sectional study was conducted on 40 patients of age group between 12-85years with clinically suspected adnexal mass and those which were incidentally found on USG were subjected to MRI using a standard protocol. Characteristic features of various adnexal lesions were compared on both ultrasonography and MRI.

Results: The final diagnosis for each 50 masses (in 40 patients) was established by, histopathology -39 rest on follow up. In the present study, the sensitivity, specificity and accuracy of USG in diagnosing malignancy were 100%, 91% and 94.8% respectively. The sensitivity, specificity and accuracy of MRI in diagnosing malignancy were 100%, 97% and 97.43% respectively

Conclusion: In majority cases, the accuracy of ultrasound in diagnosing adnexal lesions was similar to that of the MRI however extent and epicenter was better determined on MRI. One should avoid economic burden to the patient by suggesting follow up on ultrasound for benign lesions and MRI should be advised only in large lesions and suspected case of malignancy or no reduction in size of the lesion on follow up.

Keywords: Adnexal Lesions, Ovarian Cysts, Ovarian Tumors, Complex Adnexal Cyst, Ultrasonography, Magnetic Resonance Imaging

INTRODUCTION

Adnexal lesions are commonly seen in women of reproductive age group however they can occur at any age group. These lesions vary from benign to malignant however, benign lesions outnumbers malignant lesions. There are numerous differentials for adnexal lesions which makes it more difficult for Radiologist to give an accurate diagnosis based on only one modality. Ascertaining the benign aspect of the mass via imaging avoids the patient from undergoing unnecessary surgery and palliates patients concern. On the contrary, malignant masses must be detected at early to ensure that the patient receives timely treatment.

Ultrasonography and MRI are two most commonly used modalities which are used in pelvic pathology assessment. Ultrasonography is the key imaging modality in female patients with the clinically suspected pelvic disease. USG has been very useful for detecting and characterizing adnexal mass. USG is widely available and is advantageous as the procedure is simple, safe, and economical. However, the drawbacks associated with Ultrasound includes low specificity in detecting malignancy, restricted field of view, and bowel gas obscuring the pelvic organs, the requires for skilled and experienced operator.[1]

MRI has evolved as a crucial modality in the investigation of pelvic pathologies. MRI shows excellent soft-tissue contrast, larger field of view and direct multiplanar proficiencies, hence, can more efficiently describe and characterize normal anatomy of the pelvis and its pathology. Many studies have shown that adnexal lesion characterization are found to be highly accurate on MRI. This modality is non-invasive, requires no anaesthesia and has no risk of radiation. MRI is regarded as the next leap in evaluation of sonologically indeterminate masses and as the predominant modality for assessing gynaecological malignancies. On the contrary, MRI is relatively expensive and not readily available, unlike USG.[2]

MATERIAL AND METHODS

This was a cross sectional study in which total number

of 40 female patients of age group between 12-85 years with suspected adnexal mass and those which were found incidentally on USG were subjected to MRI. Patients were followed up to correlate the findings with clinical outcome, operative findings and histopathological findings. Institutional ethical clearance was obtained before initiations of the study. Informed consent form was obtained from the concerned patient.

Inclusion criteria

- All female patients with clinically suspected cases of adnexal mass lesions
- Adnexal mass lesions found incidentally on USG

Exclusion criteria

- Clinically and sonologically proved cases of ectopic pregnancy.
- All Patients having cardiac pacemakers, prosthetic heart valves, cochlear implants or any metallic implants.
- Patients having history of claustrophobia.

Interventions

Patients detected with adnexal lesions on USG, either when referred to the department of Radiodiagnosis SSSMC&RI for the same or when detected incidentally were examined with Mind ray Trans Abdominal Scan with Curvilinear probe. And Trans Vaginal USG was done as and when required and a 1.5 tesla MRI using abdominal surface coils. Contrast was not used for any of the cases. The patients were followed up and findings were correlated with the clinical outcome, operative findings or histopathological findings.

Technique: Imaging will be done with 1.5 tesla Philips Achieva machine using abdominal surface coils. The following sequences will be selected as required.

a) T1WI, T2WI and STIR (in axial plane).
b) T2WI and STIR (in coronal plane).
c) T2WI and STIR (in sagittal plane).
d) T1FS (in axial and coronal plane).

CA-125

Cut off value for distinguishing between benign and malignant lesions was 35IU/ml

STATISTICAL ANALYSIS

Data was entered in the excel sheet statistical analysis done by SPSS 23 software using descriptive and inferential data statistical analysis.

RESULTS

A total of 50 masses were found in 40 patients (2 patients had 3 mass, 6 patients had bilateral and 32 patients had single mass) among which 5 were malignant and 45 were benign. Final diagnosis was confirmed by histopathology in 39 patients and rest of the lesions were followed on USG to look for change size and characterisation with or without treatment

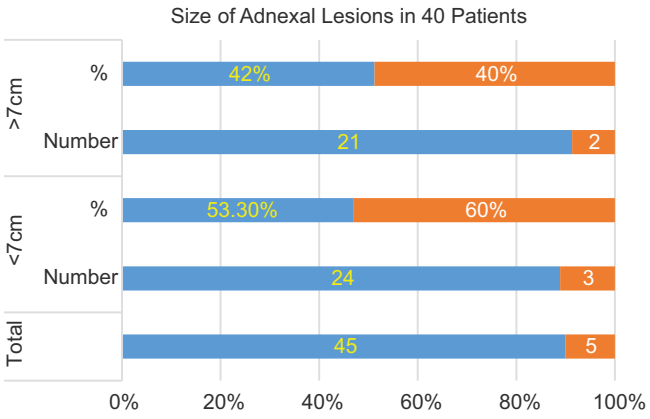
Descriptive analysis results

The majority of the patients were between 21-40 years of age group accounting for 47.5%. Majority of the patients presented with pain abdomen (90%). Most of the lesions were of arising from ovary. Most common location was right Ovary in 37.5% cases and bilateral in 17.5% cases. Most of the benign lesions were >7cm (Graph1). On USG and MRI most of the lesions were cystic (76% and 74% respectively) (Table 1).Most of the lesions with thin wall and with or without septations were benign (Table 2).

In the final diagnosis of 50 masses, sonography was as good as MRI however the origin of large lesions, extent and tissue characterizations were better on MRI. Sonography could detect the origin of mass in 46 (92%) lesions and was not able to determine in 4 (8%) of lesions. Of the 50 masses studied on MRI, origin could be detected in all the cases (100%).

Comparative analysis of USG and MRI findings

Final sonographic diagnosis of adnexal lesions out of 50 masses were same as MRI diagnosis in 46(92%) masses. Out of 50 lesions 11 lesions were with follow up on USG, which showed reduction with size and confirmed benign nature of these lesion. Rest 39 lesions were confirmed on histopathologies. On ultrasound 43(86%) lesions were reported as benign and 7(14%) lesions were reported as malignant whereas on MRI 44(88%) lesions were given as benign and 6 (12%) as malignant lesions. On histopathology 45 were benign and 5 were malignant. Two lesions on USG and one



	Total	<7cm		>7cm	
		Number	%	Number	%
Benign	45	24	53.30%	21	42%
Malignant	5	3	60%	2	40%

Most of the benign lesions were >7cm

Graph-1: Showing size adnexal lesions in 40 patients (n=50 lesions)

Components of adnexal lessions on USG	Total	%
Cystic	38	76%
Complex cystic solid	06	12%
Solid	06	12%
Size of adnexal lesions on MRI	Total	%
Cystic	37	74%
Complex cystic solid	09	18%
Solid	04	08%
On USG and MRI most of the lesions were cystic (76% and 74% respectively)		

Table-1: Showing content in adnexal lesions in 40 patients (n=50 lesions)

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Characteristics	Total	Benign		Malignant	
		Number	%	Number	%
Thin and smooth without septa	16	16	100%	0	-
Thin and smooth with septae	16	16	100%	0	-
Thick and smooth without septae	01	01	100%	0	-
Thick and smooth with septae	05	11	100%	0	-
Thick and smooth with irregular	01	00	-	1	100%
Most of the lesions with thin wall and with or without septations were benign					

Table-2: Showing wall/septa characteristics in benign and malignant lesions on MRI (n=39)

lesion on MRI were diagnosed as malignant but proved to be benign on histopathology In the present study, the sensitivity, specificity and accuracy of USG in diagnosing malignancy were 100%, 91% and 94.8% respectively**.** The sensitivity, specificity and accuracy of MRI in diagnosing malignancy were 100%, 97% and 97.43% respectively.

DISCUSSION

The current study was done in selected 40 patients with suspected adnexal lesions and had positive findings on both ultrasound and MRI.

Most of the patients with adnexal lesions were between 21-40 years of age representing 47% of total. Studies by Herman et al[3] showed incidence of adnexal lesions increases exponentially with age, incidence among women of age group 1-15 years is 0.43 per 100,000 and at the age of 35 it is 2 per 100000 women and the study by Al-Shukri et al[4] showed mean age was incidence was 29 years. 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 this study most of the patients presented with lower pain abdomen (90%) and few cases presented with mass per abdomen, backache and amenorrhea. Our finding were similar the study by Al-Shukri et al[4] in which 98% cases presented with pain abdomen

Site of Adnexal lesions: Maximum lesions were of ovarian origin. Adusumilli et al[5] noted that in all the adnexal lesions ovarian masses are most common. In present study we observed that right ovary was more commonly involved than left.

Comparison between USG and MRI in the diagnosis of adnexal lesions Origin of the mass were detected in 46(92%) lesions indeterminate in 4(8%) cases owing to their large size whereas MRI showed 100% accuracy in assessing the site of origin. Other studies by Dennis A. Sani[6] is of the same opinion that large pelvic lesions are difficult to assess on ultrasound.

Comparison of consistency of lesions: In this study we found 76% cystic, 12% complex cystic and 12% solid lesions on ultrasonography whereas MRI showed 74% cystic, 18%complex cystic and 08% solid which differed from previous studies by T.Prabha et al[7] where they showed 0% cystic, 66% solid and 42% complex lesions on USG and 27% cystic, 37% solid and 31% complex lesions on MRI

In my study on ultrasound out of 50 masses in 40 patients 43 lesions were diagnosed as benign based on their patter recognition like thin wall, anechoic, thin internal septations, no evidence of mural nodules and no internal vascularity on colour Doppler with echogenicity. And 5 lesions were diagnosed as malignant based on features like thick septations, irregular wall, large size, mural nodule and vegetations

Joshi et al[8], in their study, proposed that the application of ultrasound greyscale morphology to assess pelvic lesions may be termed as "pattern recognition."The assessment of ovarian masses, depending on their pattern recognition, showed a sensitivity of 88-100% whereas specificity was 62 -96%.

Whereas on MRI out of 50 masses 44(88%) were given as benign and 6(12%) as malignant based on their tissue characterisation, mural nodules and papillary projections as showed in study by Adusumilli et al[5], said that MR Imaging was accurate in final diagnosis for tissue content, origin and characteristics of mass.

In this study out of 50 adnexal lesions in 40 patients 39 lesions were confirmed on histopathology rest 11 were confirmed on follow up. Out of 39 lesions on histopathology 34 were benign and 5 were malignant lesion. Two lesions on USG and one lesion on MRI was diagnosed as malignant but proved to be benign on histopathology.

In the present study, the sensitivity, specificity and accuracy of USG in diagnosing malignancy were 100%, 91% and 94.8% respectively which was comparable with study by Madan et al[9] which showed sensitivity of USG in adnexal lesions was 92.5%

The sensitivity, specificity and accuracy of MRI in diagnosing malignancy were 100%, 97% and 97.43% respectively which was similar to the study by Adusumilli et al[5], that MR imaging shows 94% specificity for benignity and sensitivity was 100% in malignancy, and comparable with studies done by Guerra et al who concluded that MRI sensitivity is 98% and specificity is 93% for detecting malignancy. Dodge et al in their metaanalysis observed that MRI sensitivity was 92% and specificity was 88% in correct diagnosis of malignancy

My study supports the previous study done by Rathore OP et al[10] who concluded that the MRI and USG sensitivity in diagnosing malignant adnexal mass is same.

In this study ultrasound sensitivity was same as that MRI however specificity and accuracy was more on MRI with small percentage difference in detecting malignancy in adnexal lesions. MRI studies are economic burden for poor patient and may not available in all hospitals where as Ultrasonography is cost effective, less time consuming and final diagnosis are similar to that of MRI which makes ultrasound as primary imaging modality in adnexal lesions.

In this study I observed that accuracy of diagnosis on

ultrasound was also depended on a sonographer with skills and good knowledge regarding characteristic features of adnexal lesions and their differential diagnosis

Benign lesions like simple cysts, hemorrhagic cysts, and small paraovarian cysts, small endometroid cysts and hydrosalpinx should be followed up rather than subjecting patient for MRI. Only those patients which are suspected for malignancy, not able to assess the site of origin in large size tumors and not regressing in size on follow up scan should be subjected for MRI.

Description of various adnexal lesions seen in this study

On MRI of 40 patients with adnexal lesions, 50 lesions were detected. The adnexal lesions were cystadenomas (22%), hydrosalpinx (12%), Mucinous cystadenomas (8%), endometriomas (10%), Paraovarian cysts (8%), Hemorrhagic cysts (8%), Dermoid cysts (8%), Simple cysts (4%), Complex cysts (4%), Ovarian fibromas (4%) Infective tuboovarian masses (2%), Krukenberg tumour (4%), cystadenocarcinomas (4%), Dysgerminoma (2%).

The adnexal lesions encountered in present study were as following:

Ovarian cysts were commonly encountered in gynaecological imaging, and vary widely from physiologic, to complex benign, to neoplastic aetiology. The 1-2-3 rule is a simple method of describing the nomenclature of any small simple anechoic structure in the ovary on ultrasound <1 cm - follicle, 1-2 cm- dominant follicle, >3 cm – Cyst[11,12]

Simple ovarian cysts

In our study I had included two simple ovarian cysts which on ultrasound were well-defined, anechoic with no evidence of internal sepatation or internal vascularity. Ovarian cysts of size 7cm was subjected for MRI which was hypointense on T1 and Hyperintense on T2. Both the cysts were followed up which showed gradual reduction in size over a period of time.

Paraovarian cysts

In our study I had included four para ovarian cysts. They are simple cysts which usually occur around the broad ligament and arise from paramesonephric, mesothelial, or mesonephric remnants.[13] On Ultrasound they were thin walled cyst with smooth margins and all were unilocular. There were no soft tissue nodule. Rarely a development of a soft tissue nodule in the cyst suggests neoplasm.[14] As they were of size >7cm patients were subjected for MRI and on MRI they appeared hypointense on T1W1 and Hyperintense on T2W1. In few cases "beak sign" shape was appreciated. When a mass deforms edge of an adjacent organ into a "beak" shape then it is likely that mass is arising from that organ.

Haemorrhagic ovarian cysts

These results from internal haemorrhage within corpus luteum following release of the oocyte or within follicle that fail to regress or ovulate.[9] In my study I included four hemorrhagic cysts which on ultrasound showed thin walled cystic lesion showing reticular pattern of internal echoes from fibrin strands (Sometimes termed lace-like, fishnet, cobweb appearance) with solid appearing areas. No internal flow on color Doppler. Wall of the cyst showed circumferential flow. On Pelvic MRI Signal characteristics can vary depending on the age of the hemorrhage. All cysts were heterointense predominantly hyperintense on T1WI, hyperintense on T2WI.All cysts on follow up showed regression in the size[15,16]

Endometriomas

We included five endometriomas in our study and final diagnosis was confirmed on histopathology. On ultrasound they were unilocular cyst with diffuse homogeneous ground-glass echoes with acoustic enhancement and no internal blood flow. On MRI they appeared hyperintense on T1-weighted images hypointense on T2WI due to the presence of deoxyhemoglobin and methamoglobin. Shading sign was seen on T2WI of lesions that are Hyperintense on T1WI and low signal (T2 shortening) affecting variable portion of lesion. It may only involve small portion of lesion, typically layering dependently.[17] On T1 fat suppressed sequence, they did not show loss of signal on which differentiate it from mature cystic teratoma of the ovary, variable restricted diffusion.

Hydrosalpinx

We included four cases of hydrosalpinx, it was bilateral on two cases and associated ovarian cysts in other two cases which on ultrasound showed a thin walled in acute cases or thick walled in chronic cases, elongated or folded, dilated, C or S shaped fluid-filled tubular structure distinct from uterus and ovary. They appeared as multilocular cyst due to incomplete septations within it. On cross sections "Cogwheel" appearance is imaged due thickened longitudinal folds. In hydrosapinx these folds are pathognomonic. "Waist sign" is a strong predictor of hydrosapinx in which there is indentations on the opposite sides of the wall. Tubular-shaped cystic mass and waist sign combination with are pathognomonic of a hydrosapinx.[18] Incomplete septa gives appearance of a "beads on a string" sign. On MRI they were hypointense on T1WI and can be Hyperintense in proteinaceous content, Hyperintense on T2WI.

Tubo-ovarian absces

One case of tubo-ovarian abscess was included in the study. On ultrasound it was multilocular irregular thick walled complex adnexal mass with echogenic debris and septations are noted. On MRI it showed low signals on T1WI and high signals on T2WI.

Ovarian tumors

Ovarian serous cystadenomas: We had 11 cases of serous cystadenomas. On ultrasound they were large (≥10cm), thin walled, unilocular, clear anechoic cystic lesion with no septations, papillary projections or color flow on Doppler. On MRI they showed homogenous low signals on T1W sequences and high signals on T2W imaging with few thin septations. All lesions diagnosis was confirmed on histopathology.

Mucinous cystadenoma of the ovary: We had 4 cases of mucinous cystadenomas. All lesions diagnosis were confirmed on histopathology. Ultrasound showed large multilocular cystic lesion with thin septations with heterogeneous low level internal echoes within it due to increased mucin content. MR imaging showed variable signal intensities on

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T1 and T2WI due to fluid of various viscosity, sometimes give a "stained glass" appearance. Different locules showed different level of intensity. Large size, loculi and mural calcifications were common in mucinous cystadenoma than serous cystadenoma.[19]

Dermoid cyst: In our study we included four dermoid cysts and all four turned out to be mature cystic teratomas on histopathology. These are most common germ cell neoplasms containing atleast two germ cell layers (ectoderm, mesoderm, and endoderm). Most commonly they contain fat (75%), teeth (31%) and other tissue like hair, skin, neural, bone, muscle, gastrointestinal epithelium can also be seen. Occurs in young women (<20years) but mean age of presentation is 30 years.[20,21] On ultrasound, they showed multiple appearances, including a cyst with hyperechoic protrusion (Rokitansky nodule), diffusely or partially occupying mass with posterior acoustic enhancement due to sebaceous material and hair within cyst, an echogenic interface at the edge of mass obscuring deeper structures (tip of the iceberg sign), and multiple thin echogenic bands due to intraluminal hair (dot-dash sign), fluid-fluid levels, shadowing calcific or tooth components with no internal vascularity on color Doppler. Rarely intracystic floating balls are seen and considered characteristic feature.[21]
MRI was to identify if there is fat content. They were bright on T1-weighted imaging, variable on T2-weighted imaging. In- and out-of-phase imaging were used to demonstrate signal dropout in fat-containing lesions on out-of-phase sequences.

Ovarian fibromas: We included two histologically confirmed ovarian fibromas. These are most common benign sex cord ovarian tumour. Occurs at any age but commonly seen in middle aged women. Usually asymptomatic. In few cases they are associated with ascites and pleural effusion and this trio is termed as Meigs syndrome. Also seen in association with nevoid basal cell carcinoma syndrome.[22,23] In our cases ultrasound showed well-defined, hypoechoic solid mass with marked acoustic shadowing due to fibrous tissue. On MR imaging they were homogenously hypointense T1WI and T2WI. One of the characteristic feature of these T2 hypointense band separates the tumour from uterus on all planes. Differentials of thecoma and Fibrothecoma should be considered, these are Hyperintense on T2 due to edema and cystic degeneration and contrast enhancement is due to vascularized theca cells.[24]

Malignant ovarian tumors

Cystadenocarcinoma: There were two lesions which were proved to be Cystadenocarcinoma. On USG, these were large cystic mass with thick and irregular wall and multiple thick and irregular septae. Multiple mural nodules were also seen. On MRI, these were cystic masses with thick and irregular wall and thick and multiple irregular septae.

Germ cell tumors: We included one histopathologically confirmed case of Dysgerminoma which on ultrasound showed solid septated ovarian mass with heterogeneous echotexture with flow signal within the fibro-vascular septa on color Doppler. On MRI it was hypointense on T1WI and hyperintense on T2WI with multiple hypointense septae within it.

Krukenberg tumour: There was one case of histopathologically proven Krukenberg Tumour in bilateral ovary associated bilateral plural effusion and ascites. On USG, there were bilateral complex solid cystic mass showing vascularity on color doppler. On MRI, the bilateral enlarged ovaries were hypointense T1W images and mixed hyperintense on T2W images.

CONCLUSION

In present study we found that benign lesions are more common among adnexal lesions and serous cystadenoma are most common benign ovarian tumors. Ultrasound is the initial imaging modality in all the suspected case of adnexal lesions. Their chacteristic features on ultrasound helps us to come to the almost accurate diagnosis.In majority cases, the accuracy of the ultrasound in diagnosing adnexal lesions was similar to that of the MRI however extent and epicentre was better determined on MRI.
One should avoid unnecessary economic burden to the patient by suggesting follow up with ultrasound of benign lesions like simple ovarian cyst, hemorrhagic cyst, complex cyst, hydrosalpinx and MRI should be advised only in large lesions and suspected case of malignancy or no reduction in size of the lesion on follow up.

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