<u>**Original Research Article**</u>

To Evaluate Accuracy of Ultrasonography and Magnetic Resonance Imaging in Characterizations of Adnexal Lesions and its Correlation with Post Operative Histopathology

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Abstract

Introduction: Adnexal lesions are one of the most common gynecological pathologies are benign in nature, but the malignant ones (10 percent) if not timely intervened can be lethal. When there is a clinical suspicion of adnexal lesions primary modality of choice for diagnosis will be always ultrasonography with Doppler study. About 20% of assessed lesions could be deemed sonographically indeterminate. In such cases Magnetic resonance Imaging will be performed and comparing results of both modalities with gold standard procedure Histopathology of patients will be done. Accurate diagnosis will aid in further management.

Aim of the study: To evaluate accuracy of Ultrasonography and Magnetic resonance imaging in characterizations of adnexal lesions and its correlation with post operative histopathology.

Results: In the present study age distribution varied from 15-60 years majority were noted among 31-35 years constituting 24.3%. Main symptom was abdominal pain followed by abdominal discomfort. Most common histopathological diagnosis was hemorrhagic cyst ovary constituting to 21.6% among benign lesions, serous cystadenoma ovary constituting to 10.8%. Ultrasonography correctly detected all benign adnexal pathologies, however, MRI detected malignant lesions such as serous cystadenocarcinoma and mucinous cystadenocarcinoma which were diagnosed as benign lesions in Ultrasonography. MRI pelvis showed sensitivity of 97%, negative predictive value of 75% over Ultrasonography which showed sensitivity of 88.8% and negative predictive value of 75%.

Conclusion: As in few cases ultrasonography fails to accurately differentiate neoplastic etiology, MRI due to its excellent soft tissue characterization and anatomical delineation gives conclusive results.

Keywords: Adnexa, Ultrasonography, Magnetic Resonance Imaging.

Introduction

Adnexal mass (arising from ovary, fallopian tube, or surrounding structure) is a commonly encountered gynaecologic problem. With a wide and extensive differential diagnosis, adnexal masses become a diagnostic dilemma if organ of origin is not clearly identified. Adnexal masses can be gynaecological or non-gynaecological. It can range from physiologic follicular cysts and normal luteal cysts to ovarian cancer to bowel abscesses[1]. No age in female lifespan is spared from occurrence of adnexal masses, from intrauterine female foetuses to elderly are known to have asymptomatic to symptomatic adnexal masses.

The population and the condition under study influence the prevalence. The majority of adnexal masses are caused by primary ovarian or fallopian tube disorders, but they can also be caused by pathological enlargements of the wide ligament, uterus, colon, or retroperitoneum, or by metastatic disease from another site such the breast or stomach.(1) Adnexal masses may be incidental findings or constitute symptoms. Just a small percentage of these can be treated conservatively with frequent follow-up, but only if the condition is clearly benign. Nonetheless, the majority of adnexal masses will need surgical management. Hence, adnexal mass examination aims to distinguish between benign and malignant diseases.

The gold standard for assessing adnexal masses is still transvaginal ultrasonography. Due to its widespread availability, cheap cost, and excellent sensitivity in the detection of lesions, ultrasonography (US) is the preferred primary imaging tool for evaluating adnexal lesions. If the lesion has characteristics that make it obvious that it is benign, many women don't need any additional imaging. However, the decreased specificity of sonography for the diagnosis of benignity places restrictions on use.

It has been established that magnetic resonance imaging (MRI) has the potential to characterise the tissue of adnexal lesions and that contrast-enhanced MRI is more reliable than ultrasound for doing so.

Aim

To evaluate accuracy of Ultrasonography and Magnetic resonance imaging in characterizations of adnexal masses and correlation with histopathology.

Objective

1. To assess the role of Ultrasonography and Magnetic Resonance Imaging in evaluation of adnexal lesions
2. Characterisation of Sonologically indeterminate adnexal lesions as benign or malignant.
3. Correlation of histopathological report with ultrasound and Magnetic resonance imaging results post operatively.

Materials & Methods

The study is conducted on 37 patients in the South Indian population over 2 years period. All patients with significant clinical history or complain referred to our department. Voluson S 8 pro (linear probe-7-12mega hertz and curvilinear probe 3-5mega hertz) Ultrasound Machine and SIEMENS 1.5 tesla *Magnetic Resonance* scanner using body coil (T1 weighted images in axial and sagittal plane, T2 weighted images in axial, coronal and sagittal plane, STIR image, Fat suppression studies, FLAIR sequence). Postoperatively histopathological correlation of the same lesion will be done with Ultrasonography and Magnetic resonance imaging methods.

Inclusion criteria

Patients willing to undergo this study and for biopsy/FNAC.

Clinically suspected cases of adnexal mass lesions of all age groups.
Incidentally detected adnexal lesions on ultrasound during Ultrasound abdomen imaging.

Exclusion criteria

All cases where follow up is not possible and not willing for study.

Patients with contraindication to MRI such as on pacemakers, recent coronary stent implant, cochlear implants, and claustrophobia.

Results

All the patients included in the study were age group between 15-60yrs and the total number of participants were 37.

Multiparity participants were 36 and nulliparous were 1 participant included.

27.02% participants showed clinically relevant significant past history and 72.9% participants with negative history.

In the present study Lower, abdominal pain was most common symptom present in 48.6% followed by abdominal discomfort (27.02%), irregular cycles (27.02%), abdominal distension (21.6%).

According to distribution of adnexal mass bilaterality seen in 1(2.7%) participant, unilateral in 32(86.4%) participants and centrally in 4(10.8%) participants.

Calcification of adnexal mass found in USG is around 6(16.2%) participants and absent in 31(83.7%) participants.

Adnexal mass locularity is found to be bilateral in 8(21.6%) participants and unilocular in 29(78.3%) participants.

Ascites based on USG are found in 29(78.3%) participants and absent in 8(21.6%) participants.

Table 1: Distribution of Nodule -USG and MRI

NODULE USG			NODULE	MRI
Parameter	Frequency	Percent	Frequency	Percent
Absent	33	91.8	34	91.8
Present	4	10.8	03	8.1
Total	37	100%	37	100

Table 2: Distribution of septum characteristics – USG VERSUS MRI

SEPTUM CHARACTERISTICS – USG			SEPTUM	MRI
	Frequency	Percent	Frequency	Percentage
Absent	33	89.1	27	72.9
Present	4	10.8	10	27
Total	37	100%	37	100

Table 3: Distribution of content in MRI versus USG

Content in USG			Content	MRI
Nature of lesion	Frequency	Percent	Frequency	Percent
Cystic	32	86.4	32	86.4
Solid-cystic	5	13.5	5	13.5
Total	37	100%	37	100%

Table 4: Distribution of correlation between USG & MRI of Adnexal Lesions

USG diagnosis	MRI diagnosis	Remarks
Right ovarian simple cyst (n=3)	Right ovarian simple cyst (n=3)	True positives
Bilateral ovarian simple cyst (n=1)	Bilateral ovarian simple cyst (n=1)	True positives
Right side Pyosalpinx (n=2)	Right side Pyosalpinx (n=2)	True positives
Left side pyosalpinx (n=1)	Left side pyosalpinx (n=1)	True positives

| Endometrioma right ovary (n=3)	Endometrioma right ovary (n=3)	True positives
Tub ovarian mass (n=3)	Tub ovarian mass (n=3)	True positives
Hemorrhagic cyst ovary (n=4)	Hemorrhagic cyst ovary (n=4)	True positives
Dermoid cyst (n=4)	Dermoid cyst (n=4)	True positives
Left ovarian torsion (n=4)	Left ovarian torsion (n=4)	True positives
Serous cystadenoma ovary (n=4)	Serous cystadenoma ovary (n=3)	True positives
	Serous cystadeno carcinoma ovary (n=1)	False negatives
Mucinous cystadenoma (n=3)	Mucinous cystadenoma (n=2)	True positives
	Mucinous cystadenocarcinoma (n=1)	False negatives
Mucinous cystadenocarcinoma (n=1)	Mucinous cystadenocarcinoma (n=1)	True negatives

Sensitivity, specificity, positive predictive value, negative predictive value of MRI was found to be 93.7%, 100%, 100% and 33.3%

Table 5: Distribution of correlation between MRI and HPE of Adnexal Lesions

MRI diagnosis	HPE DIAGNOSIS	REMARKS
Right ovarian simple cyst (n=3)	Right ovarian simple cyst (n=3)	True positives
Bilateral ovarian simple cyst (n=1)	Bilateral ovarian simple cyst (n=1)	True positives
Right side Pyosalpinx (n=2)	Right side Pyosalpinx (n=2)	True positives
Left side pyosalpinx (n=1)	Left side pyosalpinx (n=1)	True positives
Endometrioma right ovary (n=3)	Endometrioma right ovary (n=3)	True positives
Tub ovarian mass (n=3)	Tub ovarian mass (n=3)	True positives
Hemorrhagic cyst ovary (n=4)	Hemorrhagic cyst ovary (n=4)	True positives
Dermoid cyst (n=4)	Dermoid cyst (n=3)	True positives
	Immature teratoma (n-1)	False negatives
Left ovarian torsion (n=4)	Left ovarian torsion (n=4)	True positives
Serous cystadenoma ovary (n=3)	Serous cystadenoma ovary (n=3)	True positives
Serous cystadeno carcinoma ovary (n=1)	Serous cystadeno carcinoma ovary (n=1)	True negatives
Mucinous cystadenoma (n=2)	Mucinous cystadenoma (n=2)	True positives
Mucinous cystadenocarcinoma(n=2)	Mucinous cystadeno carcinoma (n=2)	True negatives

Sensitivity =97%, Specificity=100%, Positive Predictive Value =100%, Negative Predictive Value =75%

Illustrative cases

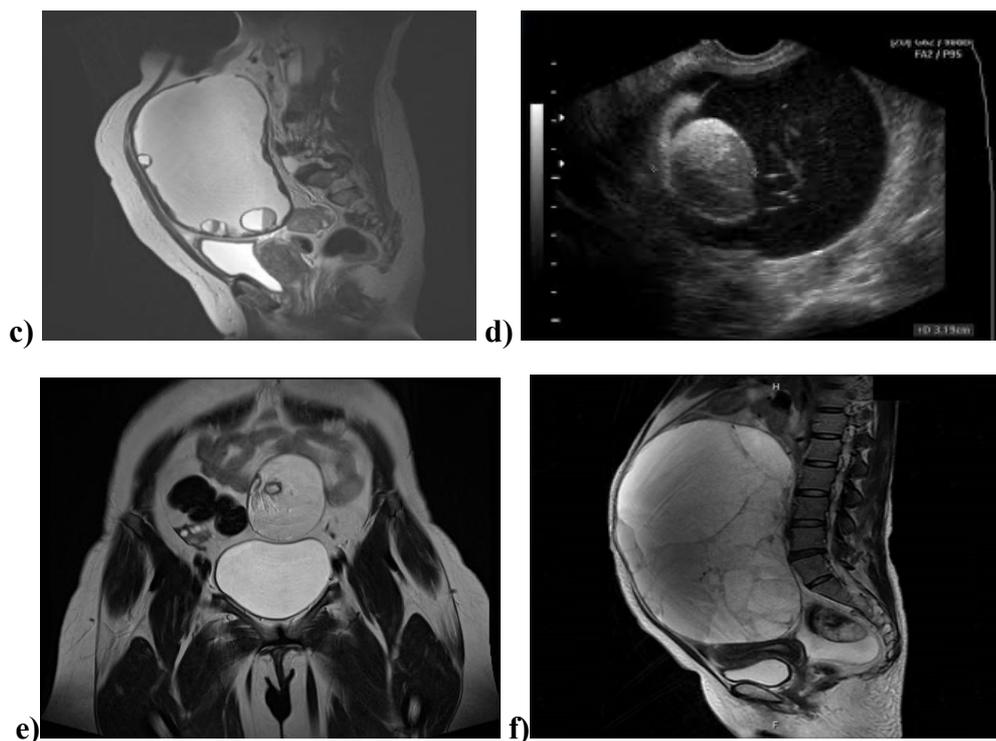a)   b)
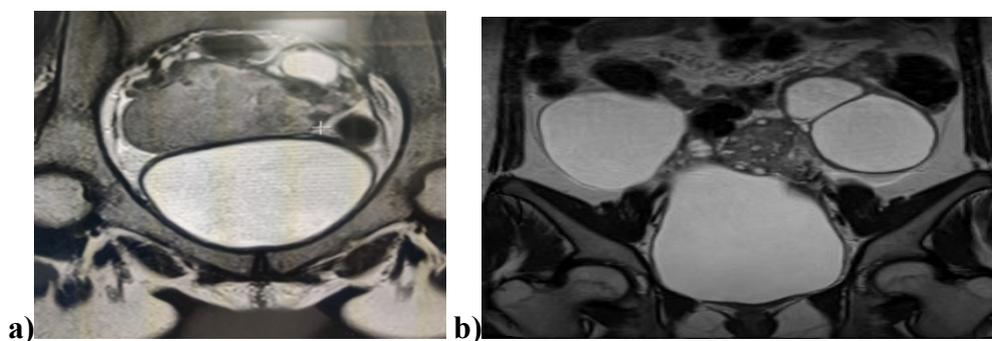
Figure 1 :a) T2 coronal -well defined tubo-ovarian mass with cystic component within located in the centre likely to be arising from right adnexa , b) T2 coronal- Left ovary shows multiple well defined complex cystic lesion, follicles displaced peripherally and hetero-intensity-left ovarian torsion secondary to complex cysts in left ovary, c) T2 sagittal-large multilocular cystic lesion with irregular thick wall extending till umbilicus- Serous cystadenoma ovary, d) USG -dermoid cyst with nodule, e) T2 coronal-Dermoid cyst showing nodule with in it, f) sagittal image shows well defined multiloculated cystic lesion with septations –mucinous cystadenoma.

Discussion

A MRI of a ≥ 7 cm ovarian cyst revealed hypointense T1 and hyperintense T2 signals. Histopathology revealed that the USG and MRI diagnoses were accurate.

On ultrasound, 8 hemorrhagic cysts were visible as thin-walled cystic lesions with reticular patterns. The features of the pelvic MRI signal depend on the age of the haemorrhage. In T1WI and T2WI, all cysts were primarily hyperintense. Both the USG and the MRI provided accurate diagnoses.

In both USG and MRI, 3 endometriomas were successfully identified. An ultrasound revealed a unilocular cyst with widespread homogenous ground glass echoes and acoustic enhancement. Due to the presence of blood by products, they looked hyperintense on T1-weighted MRI images and hypointense on T2WI. T2WI displayed a shading signal.

Three cases of pyosalpinx were examined using USG and MRI; the results revealed thin and thick walls in the acute and chronic cases respectively. USG also revealed an elongated, dilated, S-shaped, fluid-filled tubular structure that was separate from the uterus and the ovary and had partial septations.

One case diagnosed as complex cyst in USG turned out to be peritoneal inclusion cyst on MRI.

In this investigation, three tubo-ovarian abscess cases had accurate MRI and USG diagnoses. On ultrasound, adnexal mass appeared multilocular, thick-walled, filled with echogenic debris. Low signals on

T1WI and high signals on T2WI were visible on MRI.

Four cases of large (≥10cm), thin-walled, unilocular, clear anechoic cystic lesions with septations, and lowered RI on doppler on ultrasound were diagnosed as serous cystadenoma ovary. One of these was identified on MRI as serous cystadenocarcinoma. In T1W sequences, the lesion had uniformly low signals; on T2W sequences, it was hyperintense with a few thin septations and papillary projection in a malignant case.

On USG, one case of serous cystadenocarcinoma was mistakenly identified as a serous cystadenoma. The lesions were labelled as malignancy on MRI

Three cases of mucinous cystadenomas were discovered by ultrasound; MRI classified them as two cases of mucinous cystadenoma and one case of mucinous cystadenocarcinoma. MRI diagnosis was supported by histopathology. Due to the increased mucin content, ultrasound revealed a massive multilocular cystic lesion with thick septations and heterogeneous low level internal echoes. due to fluid's varying viscosity, MR imaging revealed varying signal intensities on T1 and T2 WI, occasionally giving a "stained glass" appearence.

On USG, one case of mucinous cystadenocarcinoma was incorrectly identified as benign. Which was classified as malignancy on MRI.

Four cases of dermoid cysts were detected in USG and MRI, but MRI recognised the malignant character of lesions. All appeared to be well-defined, and unilocular. T1 fat-sat MRI sequence revealed fat suppression.

All the above mentioned 37 cases were proved by histopathology report.

Comparative Studies

Present study for symptoms	Yasmeen *et al* [1]	Niharika *et al* [2]	Poonam *et al* [3]
Sample size-37 Lower abdominal pain (most common)- 48.8% abdominal discomfort and irregular cycles occupying 27.9% Abdominal distension-21%	Sample size-74 pain abdomen (75 %) abdominal distension (60 %) bleeding per vaginum (56 %).	Sample size-40 lower abdominal pain (65%).	pain abdomen (90%).

Table 6: Distribution of USG diagnosis of ADNEXAL LESIONS

Distribution of MRI diagnosis of Adnexal lesions	Yashi *et al* [4]	Pooja *et al* [5]	Present study
Right ovarian simple cyst	3	1	03
Bilateral ovarian simple cyst	-	-	01
Pyosalpinx/hydrosalpinx	-	4	03
Endometrioma right ovary	2	5	03
Tub ovarian mass	-	1	03
Hemorrhagic cyst ovary	-	4	08
Dermoid cyst	1	4	04
Complex cyst	-	-	01
Left ovarian torsion	-	-	03
Serous cystadenoma ovary	6	11	04
Mucinous cystadenoma	1	4	04
Ovarian malignancy	9	2	-

Present study	Yashi *et al* [4]	Pooja *et al* [5]	Tarek *et al* [6]	Ramya *et al* [7]
91.8% lesions were cystic and 8.1% were solid cystic. septum is seen in only 10.8% lesions. Ascites - 21.6% lesions.	Cystic (43.7%) No septae -10 cases (41%) benign masses (4.5%) malignant masses. Thin ≤3mm septa - (13.6%) benign masses (4.5%) malignant masses. Thick septa (>3mm) - (9.1%) benign masses (27.3%) malignant masses. 23.3% of benign group – ascites 80% of malignant group -ascites (p<0.05) Metastasis detected by USG in Malignant group was only in 1 case.	76% cystic 12% complex cystic 12% solid lesions on ultrasonography	(34%) - cystic tumors (14%) -solid tumors.	solid cystic nature - 15.6% Septal thickness > 3mm -7 cases, Nodularity (11.6%) central/septal vascularity- 26.7% (malignant)

Table 7: Distribution of MRI diagnosis of Adnexal Lesions

Distribution of MRI diagnosis of Adnexal lesions	Niharika *et al* [2]	Tarek *et al* [6]	Present study
Right ovarian simple cyst	3	15	03
Bilateral ovarian simple cyst	-		01
Right side Pyosalpinx	-		02
Left side pyosalpinx	-		01
Endometrioma right ovary	1	10	03
Tub ovarian mass	4	5	03
Hemorrhagic cyst ovary	2	5	08
Dermoid cyst	1	25	04
Peritoneal cyst	1		01
Serous cystadenoma ovary	8	15	02
Serous cystadenocarcinoma ovary	3	15	2
Left ovarian torsion	-	-	03
Mucinous cystadenoma	3	15	02
Mucinous cystadenocarnioma	2	1	2

Comparative studies related to Statistical analysis

Present study	Salooja *et al* [8]	Tanusree *et al* [9]
USG Sensitivity93.7% Specificity-100%, PPV-100% NPV-93.3%. **MRI**	**USG** sensitivity-75% specificity - 96.5% PPV-99% NPV-90% **MRI** sensitivity-86.4% specificity - 94.2%. PPV -88.4%	**USG** Sensitivity-88.9%, specificity-81.3% PPV-72.7% NPV-92.9% peripheral vascularity **MRI** Sensitivity-94.4%

Sensitivity-97%, specificity-100%, PPV-100% NPV 75%.	NPV-93% accuracy of MRI to differentiate between benign and malignant masses was 91.5%.).	Specificity-93.8%, PPV-89.5% NPV-96.8%

In histopathology, Present study reported serous cystadenoma most commonly which was similar in Ramya *et al* [7] representing 44.4% of the study group. In present study among 4 Cases of ultrasonographically diagnosed cases of serous cystadenoma, 1 turned out to be malignant in both MRI and histopathology report.

1 case of ultrasonographically detected case of mucinous cystadenoma among 3 cases was diagnosed as malignant in both MRI and histopathology. Rest of the cases were correctly diagnosed in ultrasonography when compared to MRI and post operative histopathology. Hence MRI was proved superior in diagnosing malignancy over ultrasonography.

According to Arora M, *et al* [10] Serous cystadenocarcinoma was the single most common histological entity with 36.53% prevalence and a striking predominance in postmenopausal patients Tanusree *et al* showed that among 50 patients on HPE, 18 patients showed malignancy, 32 patients showed benignity. Out of 18 malignant patients, MRI correctly diagnosed 17 cases. USG correctly diagnosed 16 cases out of 18 malignant cases.

Conclusion

Transabdominal and transvaginal sonography is initial screening modality for detection and characterization of adnexal pathology due to its easy availability and cost efficiency, in few cases ultrasonography fails to accurately differentiate neoplastic etiology, MRI due to its excellent soft tissue characterization and anatomical delineation gives conclusive result in characterization of neoplasms and also aids in staging of neoplasm, post treatment follow up,

However tissue diagnosis remains as gold standard.

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