Role Of MRI Diffusion Weighted Imaging In The Evaluation Of Adnexal Masses

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Abstract

Background: *Adnexal mass is a mass that arises from the structures that are located close to the uterus like a fallopian tube, ovaries, and surrounding connective tissue. To enhance the diagnostic performance of MRI, various researchers applied newer techniques like Diffusion-weighted imaging (DWI), spectroscopy, and Dynamic contrast-enhanced MRI (DCE). We are conducting the present study to assess the diagnostic performance of diffusion-weighted imaging in evaluating adnexal masses using histopathological diagnosis as the gold standard in characterizing adnexal masses and differentiating benign and malignant masses.*

Methods: *This is a hospital-based cross-sectional study done on patients with clinical suspicion of AVN cases referred from various clinical departments who MRI Pelvis was prospectively examined in the Department of Radiodiagnosis in Santhiram Medical College and General Hospital, Nandyal. The study was done on 30 patients for 6 months in the department of Radiodiagnosis at Santhiram Medical College and General Hospital, Nandyal, Andhra Pradesh.*

Results: *Most of the patients were aged 41 to 50 years. 36.66% of patients had a size of lesion ranging from 5 to 10 cm. 13.33% of patients had a size of lesion of above 10x10 cm. 50% of patients had size of lesion below 5x5 cm. Adnexa was involved in 20% of patients, fallopian tubes in 6.66%, ovary in most of the patients. The sensitivity of MRI in detecting adnexal masses was 81.82%, specificity was 97.44%, PPV was 90%, NPV was 95% and accuracy was 94%.*

Conclusion: *For lesions that are equivocal or indeterminate on ultrasound, MRI helps in reliable imaging evaluation, especially if there is a predominant solid lesion that requires more tissue-specific characterization.*

Keywords: *Adnexal mass, fallopian tube, MRI, Diffusion-weighted imaging, diagnostic accuracy*

I.Introduction

Adnexal mass is a mass that arises from the structures that are located close to the uterus like a fallopian tube, ovaries and surrounding connective tissue. [1]

Adnexal mass can be asymptomatic and detected incidentally during the imaging for other indication. Adnexal masses include ovarian cysts, ectopic (tubal) pregnancies. Most of the adnexal masses are benign, and rarely they present as borderline tumors or invasive cancer. In the case of a benign lesion, management should be done as per the clinical need, without making the subject to extensive treatment or inappropriate surgery.[2] In cases of suspicious malignancy, referral to a specialist center can make sure of the best possible clinical outcomes. Clinical judgment on managing ovarian mass depends mainly on clinical and image findings, rather than histology. Women belonging to all age groups can present with pelvic adnexal masses among a wide range of pathologies. It is often possible to characterize these adnexal masses using a combination of radiological imaging modalities and determine their nature. [3]The incidence of ovarian malignancy was drastically increased recently. Ovarian cancer is the 3rd commonest cancer among Indian women and 8th as per the Globocan 2020 Fact sheet. Around 45000 new cases were diagnosed, and 32000 deaths occurred in 2020 due to ovarian cancer in India. [4] 28%.US, Computed Tomography (CT), and Magnetic Resonance Imaging (MRI) can be used to evaluate ovarian mass. The first imaging modality for characterization of the adnexal mass is US. But the investigation of choice is MRI as it gives better resolution in delineating anatomical structures and pathological lesions. MRI delineates the abnormalities in reproductive organs disorders properly, including myomas, ovarian mass lesions, adenomyosis, cervical lesions, endometrial malignancy etc. To enhance the diagnostic performance of MRI, various researchers applied newer techniques like Diffusion-weighted imaging (DWI), spectroscopy and Dynamic contrast-enhanced MRI (DCE). More unique techniques like these were found to be better in the detection, localization and characterization of the lesions. Hence, we are doing the present study to assess the

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diagnostic performance of diffusion-weighted imaging in evaluating adnexal masses using histopathological diagnosis as the gold standard in characterizing adnexal masses, and differentiating benign and malignant masses.

MRI well delineates the abnormalities in female reproductive organs disorders, including ovarian mass lesions, adenomyosis, cervical lesions, endometrial malignancy etc.[5] Follicle demonstration in the periphery and ovarian beak sign are classical features of ovarian pelvic mass. [6] In solid and in cystic masses, characterization is performed best by complementing basic sequences with DWI and IV gadolinium. [7,8]

MRI features of malignant masses include a size of above 4 cm, irregular wall thickness, cystic lesion with solid components, septal thickness above 3 mm, presence of nodule presence of papillary, and presence of necrosis and bright contrast enhancementt. [9,10]

DCE MRI is used help in risk stratification in cystic and solid masses. Gadolinium also helps in implant detection of ovarian ca. Due to the overlap of ADC values; DWI may be less helpful to characterize indeterminate lesions, but it helps to assess peritoneal carcinomatosis.[11-14]

II.Need For The Study
 Detection and potentially the characterization of small uterine tumours and complex ovarian cancer.
 Functional and structural information about biological tissues, without the use of ionizing radiation.

III.Objectives
1. To determine the diagnostic performance of diffusion-weighted imaging in evaluating adnexal masses.
2. Differentiating the MR features for benign from malignant lesions.

IV.Materials And Methods
Type of study: it is a hospital based cross sectional study.

Source of data: patients with clinical suspicion of avn cases referred from various clinical departments will be prospectively examined by mri pelvis in the department of radiodiagnosis in santhiram medical college and general hospital, nandyal will be included in the study.

Place of study: department of radiodiagnosis at santhiram medical college and general hospital, nandyal, andhra pradesh.

Duration of study: 6 months, november 2023 to april 2024

Sample size: the sample size is 30 and the sampling method is simple random sampling.

Inclusion criteria:
1. Patients who have given written and informed consent
2. Female patients of all age groups with adnexal masses who presented to the department of radiodiagnosis for mri examination will be included.

Exclusion criteria:
1. Patients who do not give written and informed consent.
2. The present study is limited to ovaries and adnexa, the rest of female reproductive organ pathologies were excluded.
3. Claustrophobic patients.
4. Any ferromagnetic material or implants in their body and cardiac pacemaker.

Equipment used: patients underwent mr imaging examination under a 1.5 t siemens magnetom_essenza, sygno version- sygno vh21asl36 p43 machine tim+dot system.

Criteria for malignancy include contrast-enhanced solid lesions, solid components in mixed lesions, on T2WI, and contrast-enhanced papillary projections in lesions with cystic components or septal thickness more than or equal to 3 mm.

The presence of ascites, metastasis in the peritoneum, and pelvic adenopathy were also criteria for malignancy.

Diagnostic accuracy:
TN: Benign lesion in HPE and MRI, TP: Malignant or indeterminate lesion in both HPE and MRI. FP: Malignant lesion in MRI and Benign in HPE. FN: Benign Lesion in MRI and malignant in HPE.

Ethical aspects: Informed consent was obtained from every participant in the study.

Statistical analysis: Percentages, frequencies were calculated. Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy were assessed as per the no. of true positive, true negative, false positive and false negative cases. ANOVA test was used to compare ADC values between 3 types of masses.
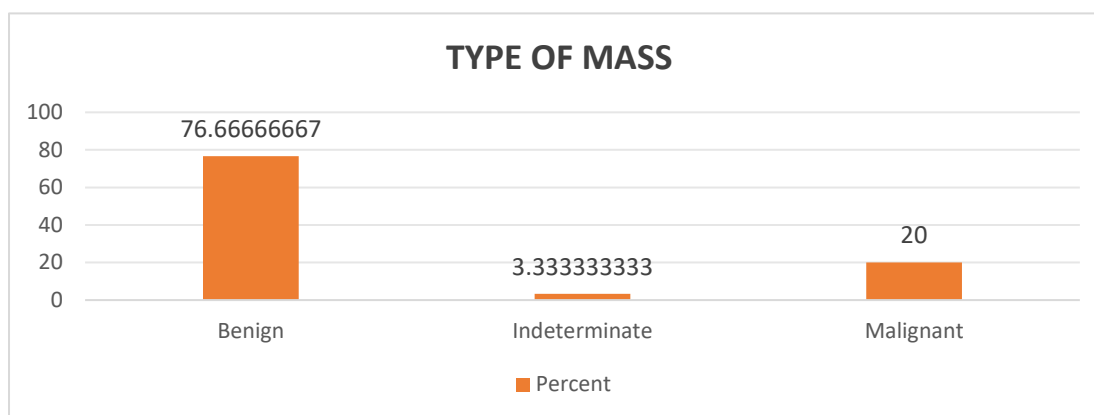
V.Results

Age: Most of the patients were aged 41 to 50 years in the current study.

AGE GROUP	Frequency	Percent
21-30	11	36.66666
31-40	4	13.3333
41-50	12	40
51-60	3	10
Total	30	100.00%

Table 1: Age group of patients

Type of lesion: 76.6% of lesions were benign. 3.33% of the lesions were indeterminate and 20% of the lesions were malignant lesions.

Graph 1: Type of mass

No of masses: All patients had single mass.
Size of adnexal lesion: 36.66% of patients had a size of lesion ranging from 5 to 10 cms. 13.33% of patients had a size of lesion of above 10x10 cms. 50% of patients had size of lesion below 5x5 cms.

Location of mass:
Adnexa was involved in 20% of patients, fallopian tube in 6.66%, ovary in most of the patients. Ovary was involved in 73.33% of patients.

LOCATION	Frequency	Percent
Adnexa	6	20.00%
Fallopian tube	2	6.66%
Ovary	22	73.33%

Table 2: Location of mass
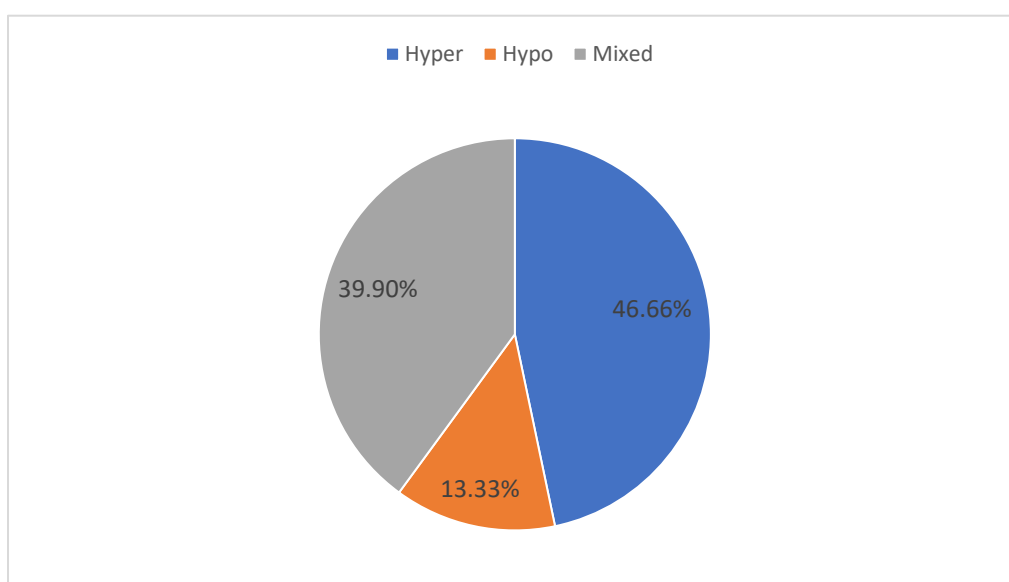
Lesions in T1 images:
33.33% of lesions were hyperintense in T1 images. 26.66% of lesions were hypointense in T1 images. 33.33% of lesions were mixed in T1 images.

Graph 2: Lesions in T1 images

Lesions in T2 images:
46.66% of lesions were hyperintense in T2 images. 13.33% of lesions were hypointense in T2 images. 39.9% of lesions were mixed in T2 images.


Graph 3: Lesions in T2 images

Diagnostic accuracy of MRI:
There were 24 true negative cases, 4 true positive cases, 2 false negative cases.

The sensitivity of MRI in detecting adnexal masses was 81.82%, specificity was 97.44%, PPV was 90%, NPV was 95% and accuracy was 94%.

Statistic	Value	95% CI
Sensitivity	66.67%	22.28% to 95.67%
Specificity	100.00%	85.75% to 100.00%
Disease prevalence (*)	20.00%	7.71% to 38.57%
Positive Predictive Value (*)	100.00%	39.76% to 100.00%
Negative Predictive Value (*)	92.31%	79.47% to 97.38%
Accuracy (*)	93.33%	77.93% to 99.18%

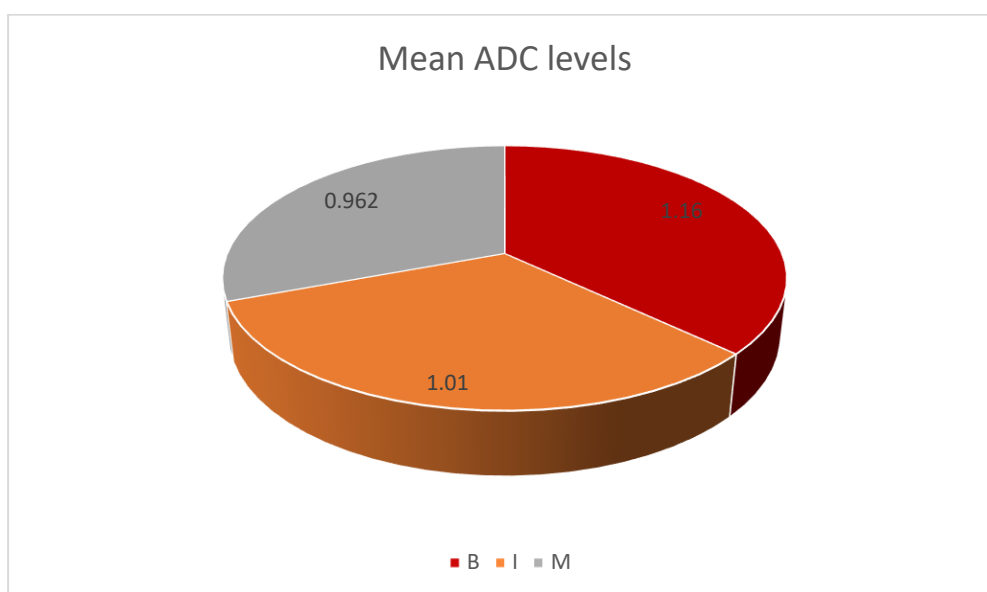**Table 3: Diagnostic accuracy of MRI in diagnosing adnexal lesions**
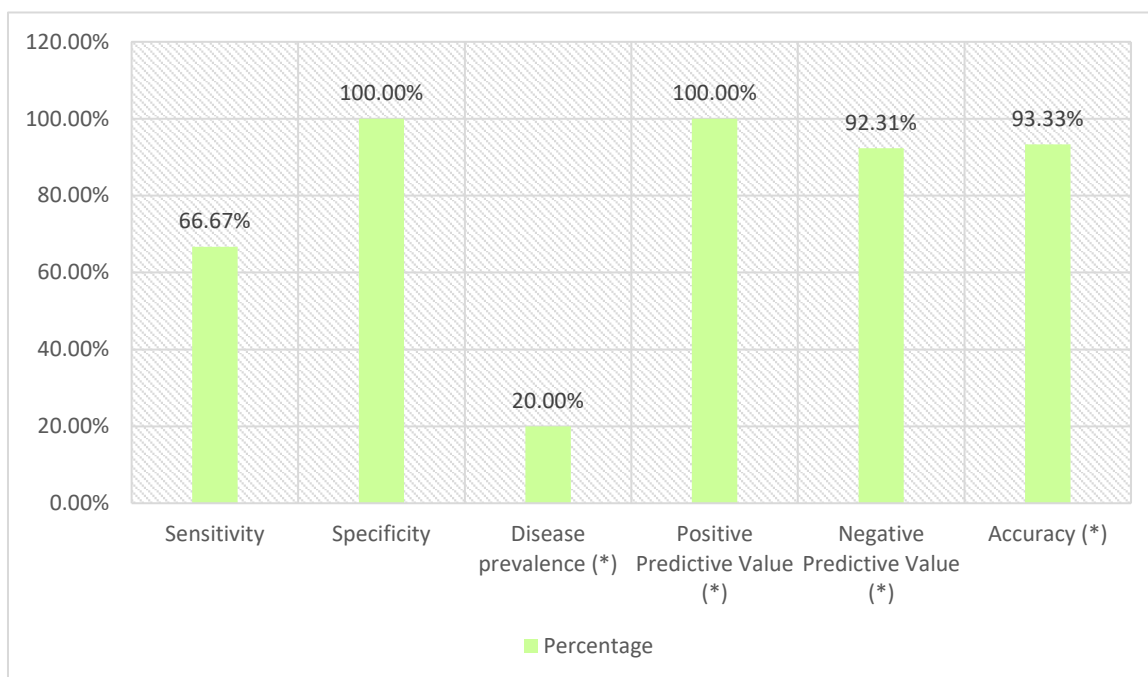
Graph 3: Diagnostic accuracy of MRI in diagnosing adnexal lesions

Mean ADC Values in various lesions:

There was a significant variation in mean ADC values between patients with 3 types of lesions (Benign, malignant and indeterminate), as per ANOVA analysis. The mean ADC in benign lesions was 1.16±0.14, It was 1.01±0.14(P=0.03) for indeterminate lesions. It was 0.96±0.34 for malignant lesions. It was less malignant lesions compared to indeterminate and benign lesions.

ADC VALUES				
Group	Number	Total	Mean	Std Dev
B	39.0000	45.4700	1.16	0.1719
I	6.0000	6.1200	1.0100	0.1497
M	5.0000	4.9100	0.9620	0.3393

Table 4; Mean ADC values in three groups

Graph 4: Mean ADC values in three groups

VI.Discussion

Most of the patients were aged 41 to 50 years in the current study and the diagnostic accuracy of MRI compared to HPE in detecting malignancy was high- 93.3%.
Mean ADC values were found to be less for malignant lesions.

Jayanathan et al. assessed the role of MRI in adnexal masses. Their study was a prospective cross-sectional study done in the department of interventional Radiology, Madurai. Patients with indeterminate masses in USG were included in the study. 90 subjects were included. The average age was 35.9 years. Most patients were aged 31 to 40 years. [15]

Zhang H et al's study included 139 patients with HPE proven adnexal masses. All subjects underwent MRI. 32 patients had ovarian cysts, 33 had endometriomas, 43 had benign tumors and 42 had malignant tumors. Benign tumors were more compared to malignant tumors similar to the current study. [16]

In the study of **Zhang H,** the average ADC value was 2.03 for benign masses and average ADC for malignant lesion was 1.39. There was a statistical difference ($P = 0$) in ADCs between the non-malignant and malignant lesions. This finding was similar to that of current study.

Fan X's study is a case-control study, which was done to assess the diagnostic values of CT and DW MRI in detecting malignancies and benign ovarian tumors.

64 patients pathologically confirmed as ovarian cancer were included in this study. Results showed predictive value in CT as 81.82% sensitivity, 84.48% specificity, 76.67% as PPV, 87.50% as NPV and 71.88% as accuracy for ovarian ca. These values in DW-MRI were 89.77%, 93.10%, 83.33%, 91.53% and 86.21%, respectively.[17]

E Inci's study has evaluated 59 ovarian masses. The study concluded that the ADC values of ovarian lesions overlap, and DWI cannot be used for differentiation of adnexal masses. They included purely cystic lesions like endometriomas, hemorrhagic cysts, and dermoid cysts, which can overlap with those of malignant masses. [18]

VII.Conclusion

For lesions which are equivocal or indeterminate on ultrasound, MRI helps in reliable imaging evaluation, especially if there is a predominant solid lesion that requires more tissue-specific characterization. We suggest large masses, whether cystic or solid have to be imaged by MRI.

Conflicts of interest: Nil

References

[1]   Nci Dictionary Of Cancer Terms [Internet]. Cancer.Gov. 2011. Available From:
        Https://Www.Cancer.Gov/Publications/Dictionaries/Cancer-Terms/Def/Adnexal-Mass
[2]   Levine D, Brown Dl, Andreotti Rf, Et Al. Management Of Asymptomatic Ovarian And Other Adnexal Cysts Imaged At Us: Society Of Radiologists In Ultrasound Consensus Conference Statement. Radiology. 2010;256:943–54. [Pmc Free Article] [Pubmed]
[3]   Buy Jn, Ghossain Ma, Sciot C, Et Al. Epithelial Tumors Of The Ovary: Ct Findings And Correlation With Us. Radiology 1991;178:811-818.
[4]   Cancer Today [Internet]. Iarc.Fr. [Cited 2024 Jul 30]. Available From:
        Https://Gco.Iarc.Fr/Today/Data/Factsheets/Populations/356-India-Fact-Sheets.Pd
[5]   Bardo Dm, Black M, Schenk K, Zaritzky Mf. Location Of The Ovaries In Girls From Newborn To 18 Years Of Age:Reconsidering Ovarian Shielding. Pediatr Radiol. 2009; 39:253–259.
[6]   Forstner R, Thomassin-Naggara I, Cunha Tm, Et Al. Esur Recommendations For Mr Imaging Of The Sonographically Indeterminate Adnexal Mass: An Update. Eur Radiol. 2017;27:2248–57. [Pmc Free Article] [Pubmed]
[7]   Thomassin-Naggara I, Toussaint I, Perrot N, Et Al. Characterization Of Complex Adnexal Masses: Value Of Adding Perfusion- And Diffusion-Weighted Mr Imaging To Conventional Mr Imaging. Radiology. 2011; 258:793–803. [Pubmed] [Crossref]
[8]   Thomassin-Naggara I, Aubert E, Rockall A, Et Al. Adnexal Masses: Development And Preliminary Validation Of An Mr Imaging Scoring System. Radiology. 2013; 267:432–43. [Pubmed]
[9]   Zhao Sh, Quiang Jw, Zhang Gf, Wang Sj, Qiu Hj, Wang L. Mri In Differentiating Ovarian Borderline From Benign Mucinous Cystadenoma: Pathologic Correlation. J Magn Reson Imaging. 2014; 39:162–6. [Pubmed] [Crossref]
[10]   Hricak H, Chen M, Coakley Fv, Et Al. Complex Adnexal Masses: Detection And Characterization With Mri – Multivariate Analysis. Radiology. 2000;214:39–46. [Pubmed]
[11]   Thomassin-Naggara I, Daraï E, Cuenod Ca, Et Al. Contribution Of Diffusion-Weighted Mr Imaging For Predicting Benignity Of Complex Adnexal Masses. Eur Radiol. 2009; 19:1544–52. [Pubmed] [Crossref]
[12]   Thomassin-Naggara I, Toussaint I, Perrot N, Et Al. Characterization Of Complex Adnexal Masses: Value Of Adding Perfusion- And Diffusion-Weighted Mr Imaging To Conventional Mr Imaging. Radiology. 2011; 258:793–803. [Pubmed] [Crossref]
[13]   Thomassin-Naggara I, Aubert E, Rockall A, Et Al. Adnexal Masses: Development And Preliminary Validation Of An Mr Imaging Scoring System. Radiology. 2013; 267:432–43. [Pubmed] [Crossref]
[14]   Forstner R, Sala E, Kinkel K, Spencer Ja. Esur Guidelines: Ovarian Cancer Staging And Follow-Up. Eur Radiol. 2010; 20:2773–80. [Pubmed
[15]   Ayanthan Ss, Sathish A, Kirankumar S, Priya Ks. Mri In The Evaluation Of Adnexal Masses With Histopathology Correlation. Int J Contemp Med Surg Radiol [Internet]. 2019;4(4).
[16]   Zhang, H., Zhang, Gf., He, Zy. Et Al. Evaluation Of Primary Adnexal Masses By 3t Mri: Categorization With Conventional Mr Imaging And Diffusion-Weighted Imaging. J Ovarian Res 5, 33 (2012). Https://Doi.Org/10.1186/1757-2215-5-33