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EVALUATION OF MAGNETIC RESONANCE IMAGING INCHARACTERISATION OF OVARIAN NEOPLASMS

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Abstract

Objective: To evaluate MRI's effectiveness in detecting malignant ovarian neoplasms and differentiating them from benign lesions, using histopathological findings as the gold standard.

Methodology: A descriptive study with diagnostic test evaluation was conducted on 50 female patients referred for MRI evaluation of ovarian lesions at Govt. T. D. Medical College, Alappuzha. MRI findings were compared with histopathology. Ovarian neoplasms were categorized based on morphology. Various criteria for malignancy detection were assessed.

Results: Using MRI, positivity for any 5 out of 6 general criteria showed: Sensitivity: 95%, Specificity: 83.33%, Positive Predictive Value: 79.17%, Negative Predictive Value: 96.15%, Accuracy: 88%

For 6 out of 6 criteria, specificity and positive predictive value increased to 100%, with slight sensitivity reduction. Adding ancillary criteria had minimal impact. Subcategories showed:

Cystic/multilocular cystic lesions: Sensitivity: 50%, Specificity: 91.67%, Accuracy: 85.71%

Solid-cystic/predominantly solid lesions: Sensitivity: 88%, Specificity: 100%, Accuracy: 92.86%

T1 hyperintense lesions: Sensitivity, Specificity, and Accuracy: 100%

Conclusion: MRI combined criteria are highly sensitive and specific for detecting malignancy, especially in T1 hyperintense lesions, but less so in cystic ovarian neoplasms. Diffusion restriction and necrosis are strong individual predictors.

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Introduction:-

Ovarian tumours are the leading indication for gynaecologic surgery.To improve patient's quality of life, laparoscopic surgery has been increasingly used in the treatment of ovarian tumours that are thought to be benign. Exploratory laparotomy is necessary in all cases of suspected ovarian cancer. Preoperative biopsy is contraindicated in ovarian masses, especially if the mass appears to be surgically resectable at the moment, as this raises the risk of spreading of cancer cells leading to iatrogenic upstaging, worsening the prognosis. Hence, preoperative characterisation of ovarian tumours can aid in surgical planning as to whether exploration or laparoscopic excision is needed, and may help distinguish benign from malignant tumours thus avoiding inappropriate management.

Magnetic resonance imaging (MRI) is being increasingly used in the current scenario, especially in cases in which ultrasonographic examination is indeterminate for accurate presurgical planning. Its multiplanar capability, excellent soft tissue resolution and lack of ionising radiation give it a better advantage compared to other imaging modalities which are currently available. However it is time consuming, not easily available and is expensive.

This study aims in evaluating the role of magnetic resonance imaging in ovarian neoplasms to predict the nature of lesion-whether benign or malignant- in comparison with histopathological findings as the gold standard.

Aim and Objective:-

Aim:-

To evaluate the role of MRI in characterisation of ovarian neoplasms and to determine their MRI characteristics, to predict the nature of the lesion- either as benign or malignant.

Objective:-

To assess the sensitivity, specificity, positive and negative predictive values, accuracy and likelihood ratios of MRI in malignant ovarian neoplasms and to assess the ability of MRI in differentiating malignant from benign ovarian lesions, using histopathological findings as gold standard.

Methodology:-

Study Design

Descriptive study with diagnostic test evaluation.

Study Period

18 months starting from Jan 2016 to June 2017.

Study Setting

Obstetrics and Gynaecology department and Department of Radiodiagnosis, Government. T. D. Medical College Alappuzha, Kerala.

Study Population

All female patients who are referred to Radiodiagnosis Department in Govt. T.D. Medical College, Alappuzha during the study period for MRI evaluation of ovarian lesions.

Inclusion Criteria
All female patients with ovarian lesions, who are referred for MRI, to Radiodiagnosis Department in Govt. T. D. Medical College, Alappuzha for further evaluation, during the study period.

Exclusion Criteria:
• Patients who are not willing to participate in the study.
• Patients who are deferred surgery for the ovarian neoplasm due to any reason.
• Patient unwilling for surgery/further treatment
• Patients in whom surgical or pathological diagnosis is not obtained on follow up.

Data Analysis
Analysis of the data was done in SPSS version 17.0. Sensitivity, specificity, positive and negative predictive values, accuracy and likelihood ratios of MRI in malignant ovarian neoplasms were calculated, using histopathological findings as gold standard.

Results:-

Of the 50 cases studied, 30 cases were histopathologically benign and others malignant. 22% of the cases were bilateral. Borderline as well as invasive malignant ovarian lesions were included under the malignant category in this study.

All ovarian neoplasms in this study are broadly divided into four major morphological types: unilocular cystic, multilocular cystic, solid-cystic, and predominantly solid.

Table 1:- Frequency, percentage and cumulative percentage of patients in the study based on age.

Age	Frequency	Percent	Cumulative Percent
<25 yrs	3	6.0	6.0
25-40 yrs	11	22.0	28.0
40-60 yrs	23	46.0	74.0
>/=60 yrs	13	26.0	100.0
Total	50	100.0	

Fig 1:- Stacked bar chart showing the number of benign and malignant tumors under the four morphological categories of ovarian neoplasms.

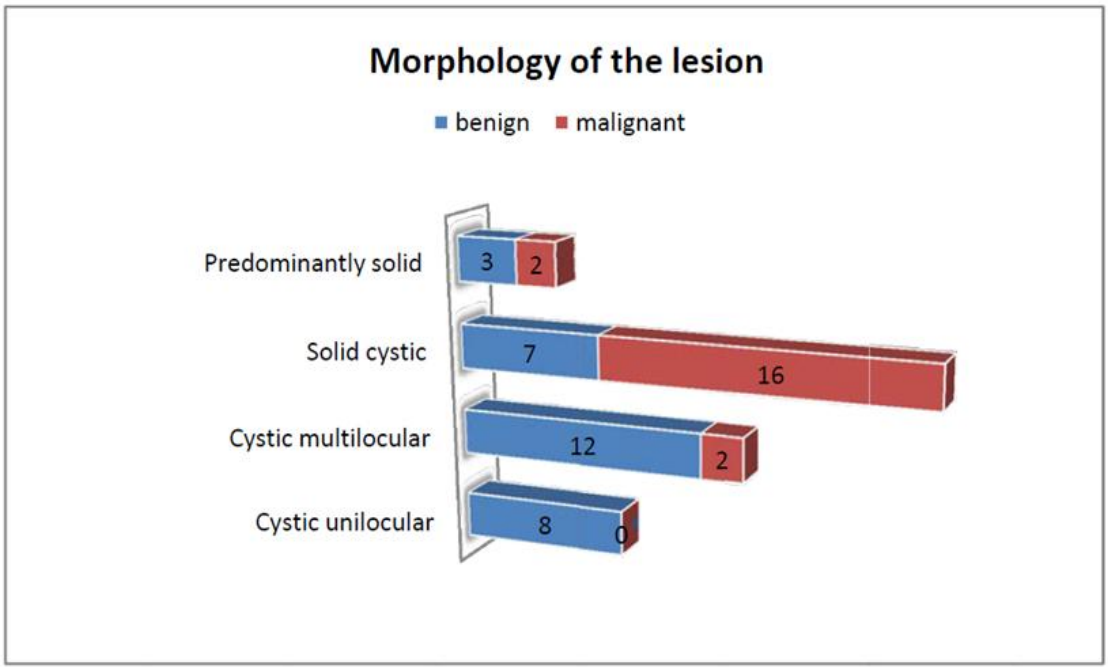


Table 2;- Percentage of frequency of histopathological types of ovarian neoplasms in the study.

Histopathological groups	Benign	Malignant
Epithelial tumours (72%)	58.3 % (52%-Serous cystadenoma)	41.6% (42%-serous papillary cystadenocarcinoma)
germ cell tumours (14%)	71.4% (100% mature cystic teratomas)	28.6%
Sex cord stromal tumours (10%)	60% (100%- fibromas)	40% (all borderline)
Metastatic tumour and others(4%)	50%	50%

These data were in concordance with that available in literature[1-7] except that according to literature, the most common benign ovarian neoplasm is mature cystic teratoma.
Test criteria included in this study for detecting malignancy can be grouped as:

- criteria applicable for all lesions
- additional criteria applicable for cystic lesions
- additional criteria applicable for multilocular cystic lesions
- additional criteria applicable for solid-cystic/predominantly solid lesions.
- additional criteria for T1 hyperintense lesions.

MRI criteria applicable to ovarian lesions of any morphology:
-Analysis of positivity of individual MR criterion to detect ovarian malignancy.
-Analysis of positivity of multiple criterias for detecting malignancy

Fig 2:- Clustered column chart showing the statistical indices of detectingovarian malignancy using individual MR criterion for any ovarian lesion.

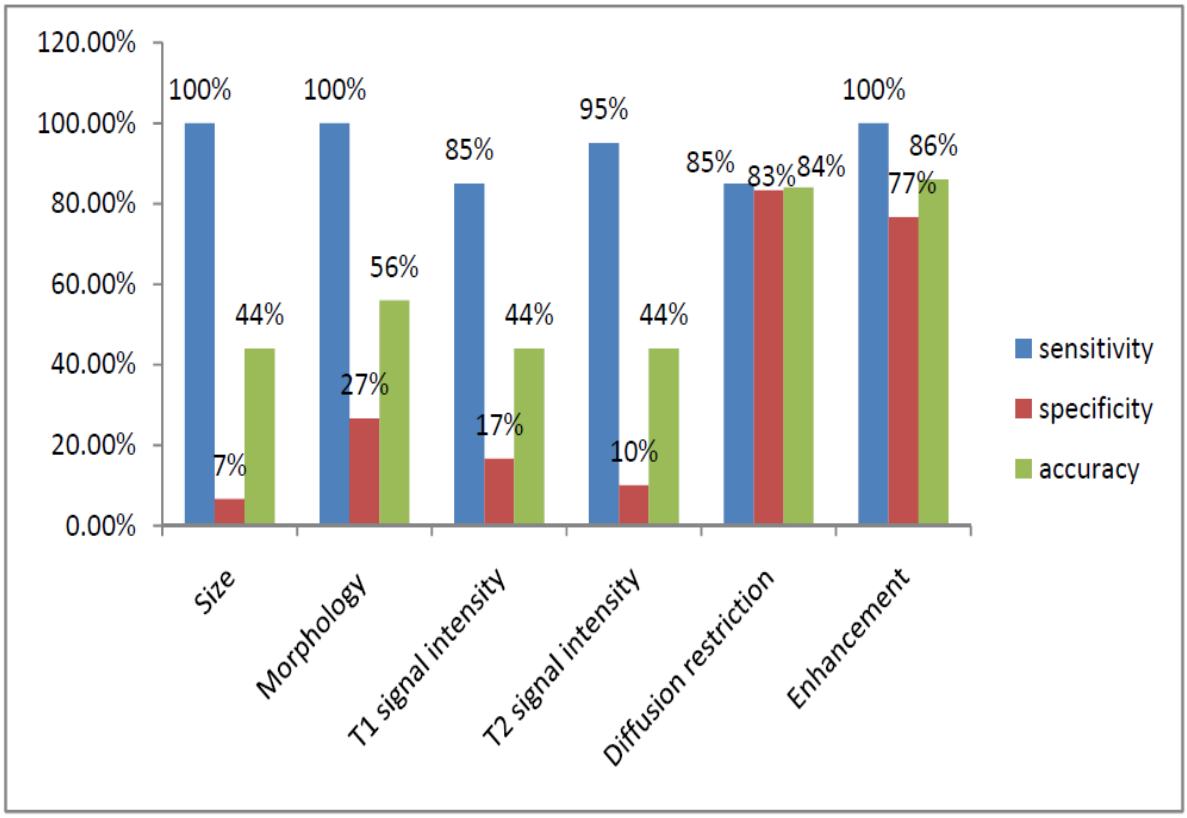
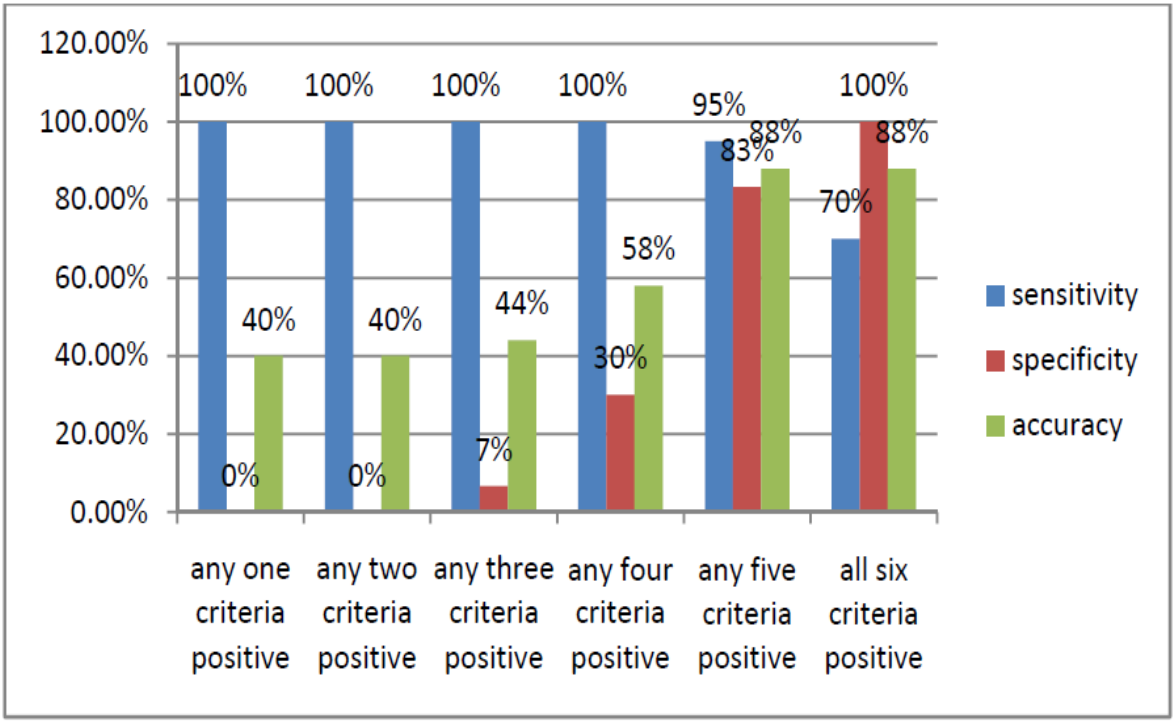


Fig . 3:- Clustered column chart showing the statistical indices of detecting ovarian malignancy using positivity of multiple criteria (general- lesion characteristics alone) for any ovarian lesion.



Lesion Characteristics (General Criteria) and Ancillary Findings:
Combining general and ancillary criteria doesn't significantly improve MRI's sensitivity, specificity, or accuracy in detecting malignancy compared to using general criteria alone.

Comparison: Individual vs. Combined MR Criteria:

- Diffusion Restriction: Similar specificity and positive predictive value as combined criteria (5 out of 6 variables), making it a strong individual variable.
- Enhancing Components: Higher sensitivity and negative predictive value, comparable accuracy to combined criteria but with slightly reduced specificity and positive predictive value.

MRI Criteria for Lesions of Different Morphologies:

1. Cystic Morphology:
Additional Criteria: Thick walls (≥3mm) and intracystic vegetations.
Thick walls have greater specificity and accuracy but poor sensitivity. Vegetations are highly sensitive but less specific and accurate.

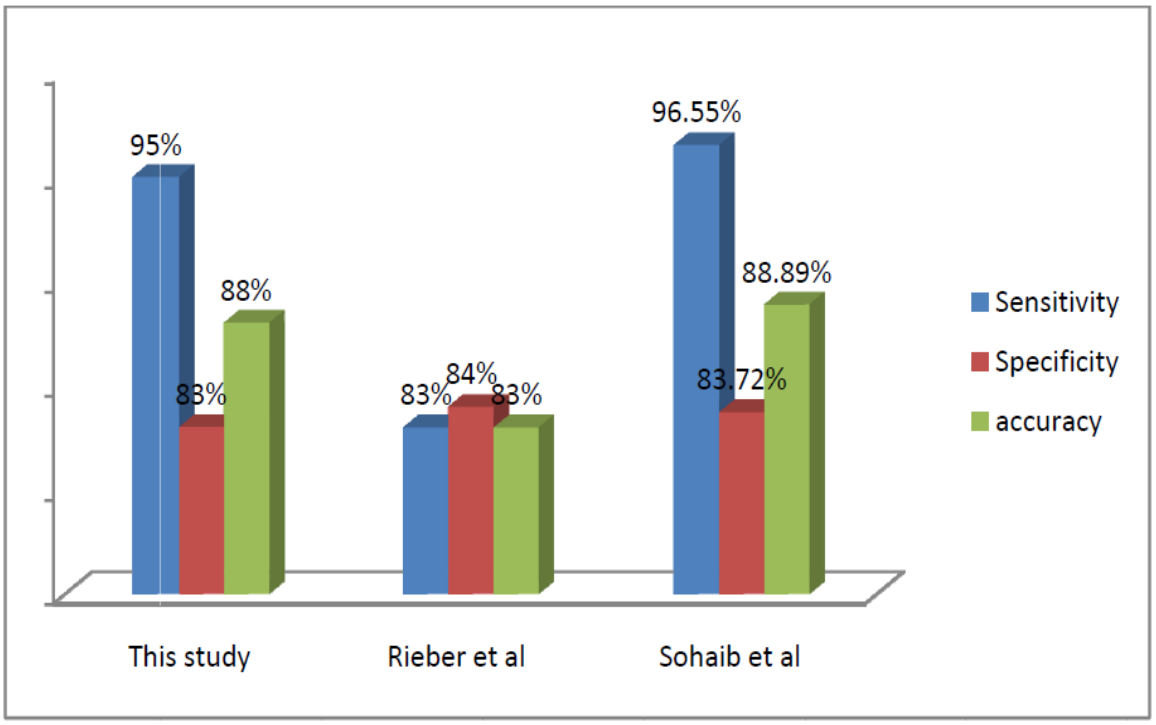
2. Multilocular Cystic Morphology:
Additional Criteria: Large number of septations (≥5) and thick septa (≥3mm).
Thick septa have high specificity but 0% sensitivity, reduced accuracy, and NPV. Large septations are less sensitive and less specific.

3. Solid-Cystic/Predominantly Solid Morphology:
Additional Criterion: Necrosis within the solid area.
Necrosis has 100% specificity and positive predictive value, but reduced sensitivity (71%) and accuracy (82%).

4. T1 hyperintensity:
Additional Criterion: Absence of fat suppression.
Similar specificity, but reduced sensitivity and accuracy compared to combined criteria.
Comparison of sensitivity, specificity and accuracy of MRI as per this study and previous studies:

Any five out of six general criteria can be used to detect ovarian malignancy by MRI with a high sensitivity and negative predictive value of 95% and 96%respectively, relatively high specificity, positive predictive value and accuracy of83%, 79% and 88% respectively.

Fig 4:- Bar chart showing comparison of sensitivity, specificity and accuracy of this study with other previous studies- Rieber et al[8] and Sohaib et al[9]



Discussion:-

Combined MR criterion using a combination of variables is superior to any individual criterion to detect malignancy in ovarian tumours of any morphology/signal intensity as well as in any of the various subcategories (namely, cystic/multilocular cystic/solid-cystic or predominantly solid/T1 hyperintense ovarian neoplasms).

Using a combined MR criterion (positivity of 5 out of 6 general criteria), the sensitivity is 95%, specificity is 83.33%, positive predictive value is 79.17%, negative predictive value is 96.15%, and accuracy is 88%.

Using all 6 general criteria increases specificity and positive predictive value to 100% but slightly reduces sensitivity and negative predictive value.

Ancillary Criteria: Adding 4 ancillary criteria does not significantly improve detection statistics.

Subcategories:

Cystic Tumours:

Adding two morphological criteria increases sensitivity to 100%, specificity to 80%, positive predictive value to 33.33%, and accuracy to 81.82%.

Multilocular Cystic Tumours:

Adding two morphological criteria yields sensitivity of 50%, specificity of 91.67%, positive predictive value of 50%, and accuracy of 85.71%.

Solid-cystic/Predominantly Solid Tumours:
Adding necrosis as a criterion results in sensitivity of 88%, specificity of 100%, positive predictive value of 100%, and accuracy of 92.86%.

T1 hyperintense Tumours:
Adding absence of signal loss/fat suppression achieves 100% sensitivity, specificity, positive predictive value, and accuracy.

Specificity and Accuracy:
Combined MR criterion is highly effective, especially in T1 hyperintense tumours, with 100% sensitivity, specificity, and accuracy. Less specificity and accuracy in cystic ovarian lesions, though more sensitive.

Individual Variables:
Most sensitive variables are large size, multilocular cystic/solid-cystic morphology, T1 hypo/isointensity, T2 iso/hyperintensity, intracystic vegetations.

Most specific variables (100%):
Thick walls in cystic neoplasms, necrosis in solid-cystic tumours, absence of fat suppression in T1 hyperintense lesions.

Highest accuracy:
Absence of fat suppression in T1 hyperintense lesions, followed by enhancing components (100% sensitivity, low specificity).

Comparison:
Presence of diffusion restriction and necrosis as individual criteria are as effective as combined criteria in detecting malignancy.

Fig. 5:- MRI axial T2W and post contrast T1W images in a 59 year old female showing a large multiloculated abdominopelvic cystic lesion with numerous enhancing grouped septations and solid areas. HPR proved to be mucinous adenocarcinoma right ovary.

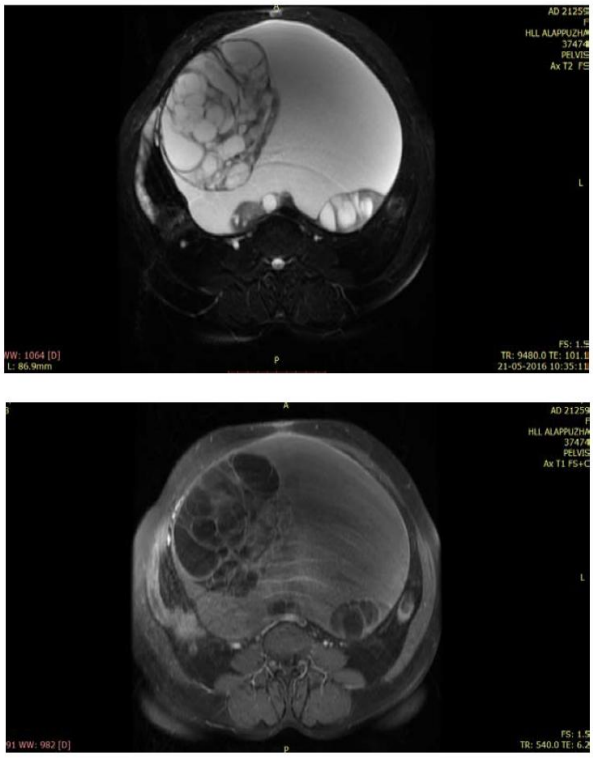


Fig. 6:- MRI sagittal post contrast T1fs images showing a irregular enhancing solid abdominopelvic lesion with necrosis in a 60 year old female. HPR: serous cystadenocarcinoma.

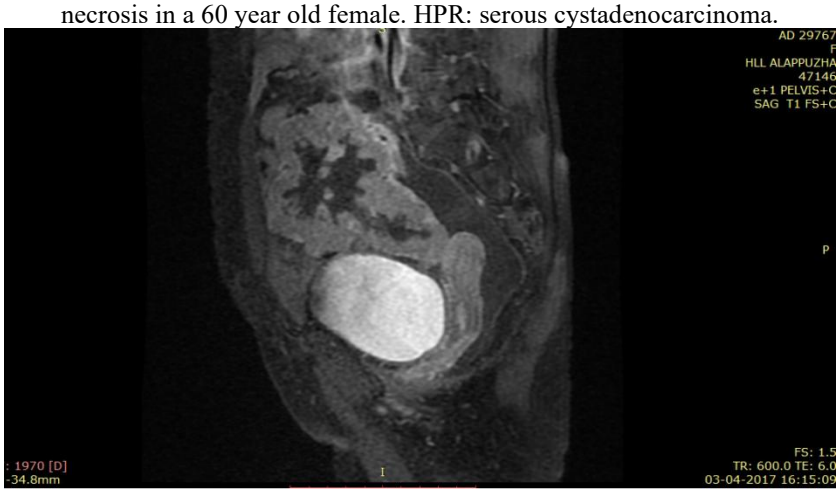


Fig. 7:- MRI Axial 2D FIESTA in a 20 year old female showing a unilocular large cystic lesion from right ovary with few papillary projections. HPR: Serous cystadenofibroma.

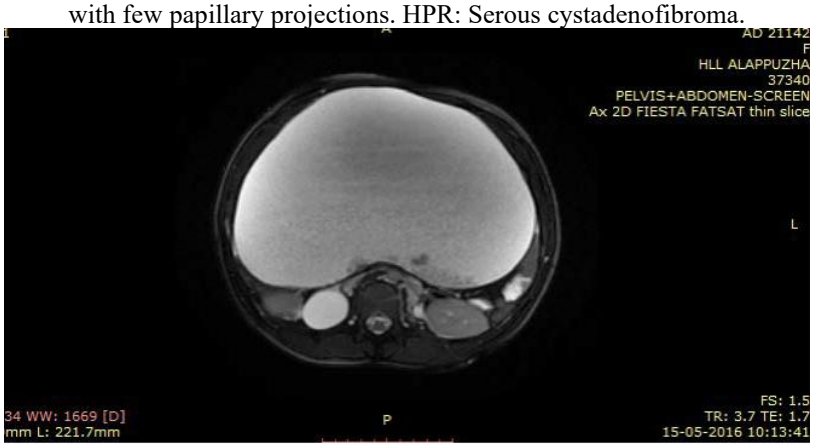


Fig. 8:- MRI Sagittal T2 W image showing a multiloculated cystic lesion from left ovary in a 46year old female. HPR: mucinous cystadenoma.

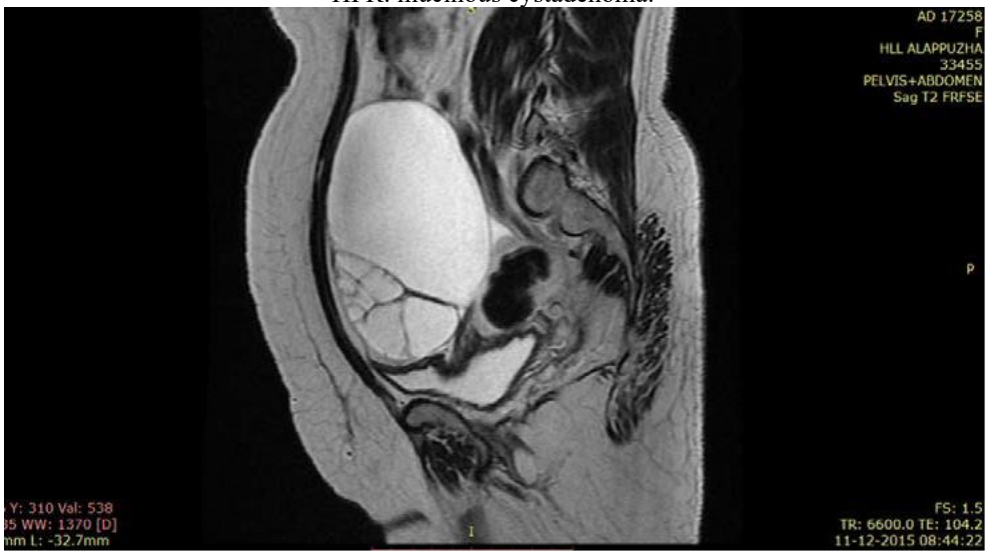
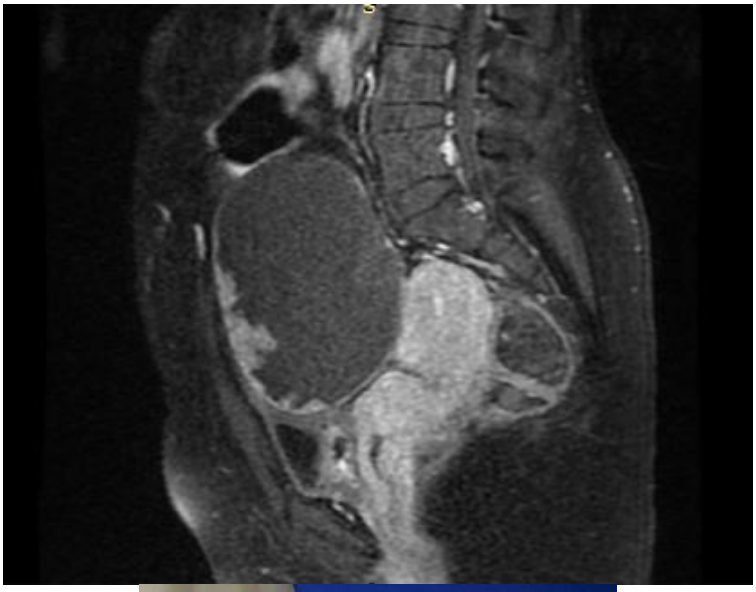
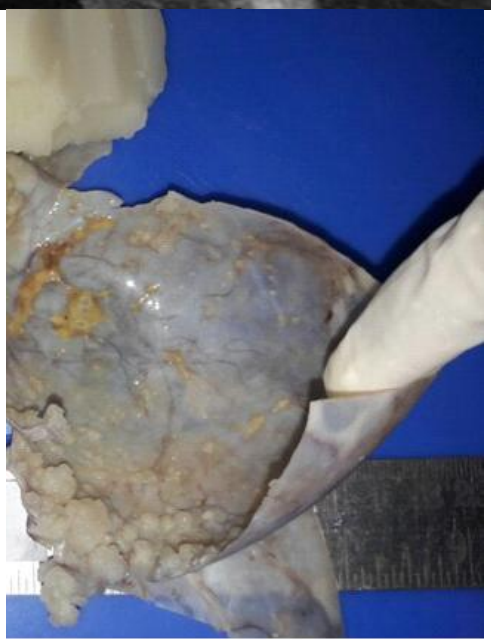
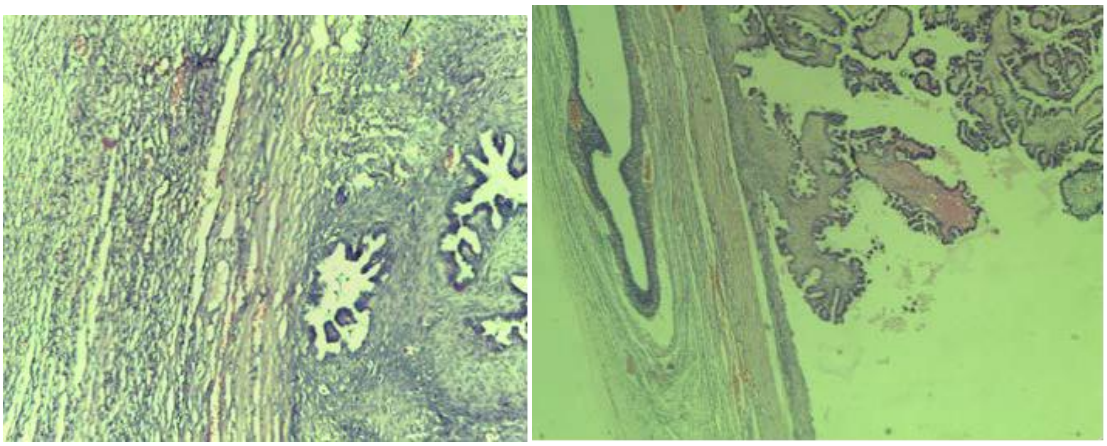


Fig. 10:- A cystic lesion with profuse enhancing papillary excrescences in a 35 year old female. The lesion was multiloculated. Left ovary also showed a similar lesion. Postoperative picture and H & E sections shown.HPR:borderline serous ovarian tumour with foci of microinvasion <3mm.







Conclusion:-

Combined MR criterion is highly sensitive and accurate for detecting malignancy in ovarian tumours of any morphology/signal intensity. Adding ancillary criteria doesn't significantly change statistical indices. Highest specificity, sensitivity, and accuracy are in T1 hyperintense ovarian neoplasms; least specificity and accuracy in cystic ovarian neoplasms.

Considering the individual variables, presence of diffusion restriction in ovarian neoplasms and necrosis in predominantly solid/solid-cystic ovarian neoplasms are strong predictors, albeit slightly inferior to the combined MR criterion.

Limitations of Study:-

- Some variables have subjective elements, leading to potential interobserver variability not addressed in this study.
- The small sample size reduces the study's reliability.
- Dynamic contrast-enhanced study could not be performed due to technical limitations, reducing the specificity of enhancement patterns in ovarian lesions.

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