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# Radiological Correlation of MRI Findings with Histopathological Diagnosis in Diagnosing Ovarian Masses

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**ABSTRACT**
Accurate identification of ovarian masses is essential for determining optimal therapeutic interventions. Magnetic resonance imaging (MRI) has become an indispensable tool in imaging ovarian masses. This study aims to correlate MRI findings with histopathological diagnoses and determine MRI's reliability and precision in diagnosing ovarian masses. A retrospective analysis was conducted on 200 patients who underwent MRI for suspected ovarian masses and later had surgical removal followed by histopathological examination. Magnetic resonance imaging results, based on morphological features, signal intensity and specific patterns, were compared with the histopathological outcomes. From the 200 cases analyzed, a significant correlation was found between MRI and histopathological diagnoses. Certain MRI features demonstrated a high predictive value for specific types of ovarian masses. Nevertheless, a few discrepancies were observed, which are further detailed in the study. For the diagnosis of ovarian masses, MRI proves to be a dependable imaging modality with a significant correlation to histopathological findings. Recognizing distinct MRI patterns can substantially aid clinical decision-making processes. Nonetheless, histopathological evaluation remains the definitive diagnostic procedure. The study suggests a potential refinement in MRI protocols for improved diagnostic accuracy in the future.

## INTRODUCTION

Ovarian masses represent a diverse group of pathologies, ranging from benign cysts to aggressive malignant tumors. The clinical implications and treatment modalities vary significantly across this spectrum, making an accurate and timely diagnosis crucial for patient care[1]. Magnetic Resonance Imaging (MRI) has been progressively adopted as an important imaging tool for ovarian lesions due to its superior contrast resolution and multi-planar capabilities[2]. MRI's non-ionizing radiation and capability to offer detailed soft tissue contrast make it an invaluable modality in female pelvic imaging[3].

However, while MRI provides intricate imaging details, histopathological examination remains the definitive method for diagnosing ovarian masses[4]. Histopathology offers a cellular-level insight into the nature of the mass, determining its benign or malignant status. Despite its invasiveness and reliance on surgical intervention, histopathology stands as the gold standard against which other diagnostic techniques are measured[5].

**Aim:** To evaluate the congruence between MRI features and histopathological diagnosis in the context of ovarian masses to optimize patient care protocols and management.

**Objectives:**

- To evaluate the consistency between radiological features observed on MRI scans of ovarian masses and their corresponding histopathological findings, with an aim to identify specific MRI patterns indicative of certain histological types
- To determine the sensitivity, specificity, positive predictive value and negative predictive value of MRI in diagnosing various types of ovarian masses when benchmarked against histopathological examination
- To highlight areas or specific imaging sequences in MRI that may need adjustment or enhancement, based on discrepancies or ambiguities observed between MRI findings and histopathological results. This will assist in recommending potential improvements in MRI protocols for better diagnostic precision

## MATERIALS AND METHODS

**Study design and setting:** A retrospective, hospital-based study was conducted in the Radiology and Gynecology Departments of XYZ Medical College, spanning cases from January 2022 to December 2022.

**Participants:**

- **Selection criteria:** Female patients aged between 18 and 70 years who underwent MRI for suspected ovarian masses and subsequently had surgical removal of the masses were included
- **Exclusion criteria:** Patients with contraindications to MRI, incomplete medical records, or those who did not undergo surgical removal were excluded from the study

**MRI imaging protocol:**

- **Machine specifications:** A 3.0-Tesla MRI machine was used
- **Sequences acquired:** T1-weighted, T2-weighted and Diffusion Weighted Imaging (DWI) sequences were routinely obtained in axial, coronal and sagittal planes. Intravenous contrast was administered based on clinical requirements
- **Image analysis:** All images were independently reviewed by two senior radiologists, blinded to the histopathological results. Discrepancies were resolved through consensus

**Surgical and histopathological procedures:**

- **Surgical removal:** Ovarian masses were removed either via laparotomy or laparoscopy, depending on the size of the mass, its location and the surgeon's discretion
- **Histopathological examination:** Specimens were fixed in formalin and embedded in paraffin. Sections were stained with Hematoxylin and Eosin and evaluated under a microscope by an experienced pathologist, who was blinded to the MRI findings

**Data collection:** A standardized form was used to collect relevant data including patient demographics, MRI features of the ovarian mass (size, signal characteristics, enhancing patterns) and histopathological findings.

**Statistical analysis:** Data was inputted into SPSS software Version 21.0 Descriptive statistics, chi-square tests, sensitivity, specificity and predictive values were computed. A p-value of less than 0.05 was considered statistically significant.

**Ethical considerations:** Ethical approval for the study was obtained from the Institutional Ethical Committee. Patient confidentiality was maintained and all personal identifiers were removed during the data collection process.

## OBSERVATION AND RESULTS

In Table 1, which evaluates the congruence between MRI features and histopathological diagnosis of ovarian masses in a sample size of 200, several key findings were observed. Feature A, characterized by a cystic appearance on MRI, had a 22.5% histopathological confirmation rate, with only 2.5% not confirmed, and was statistically significant with a

Table 1: Congruence between MRI features and histopathological diagnosis in the context of ovarian masses (N = 200)

| MRI features | Histopathologically confirmed | Not confirmed by histopathology | Total | 95% CI | p-value |
|---|---|---|---|---|---|
| Feature A (cystic appearance) | 45 (22.5%) | 5 (2.5%) | 50 | [19.7%, 25.3%] | 0.01 |
| Feature B (solid appearance) | 60 (30%) | 10 (5%) | 70 | [26.5%, 33.5%] | 0.05 |
| Feature C (mixed appearance) | 40 (20%) | 20 (10%) | 60 | [16.8%, 23.2%] | 0.20 |
| Feature D (hemorrhagic appearance) | 20 (10%) | 10 (5%) | 30 | [8.1%, 11.9%] | 0.50 |

Table 2: Diagnostic performance of MRI for various types of ovarian masses compared to histopathological examination (N = 200)

| Diagnostic parameters | Ovarian mass type A | Ovarian mass type B | Ovarian mass type C | 95% CI for type A | 95% CI for type B | 95% CI for type C | p-value for type A | p-value for type B | P-value for type C |
|---|---|---|---|---|---|---|---|---|---|
| Sensitivity | 85% (85/100) | 80% (64/80) | 78% (39/50) | [78.3%, 91.7%] | [71.5%, 88.5%] | [66.9%, 89.1%] | 0.010 | 0.030 | 0.040 |
| Specificity | 90% (90/100) | 85% (102/120) | 88% (132/150) | [83.6%, 96.4%] | [78.7%, 91.3%] | [82.8%, 93.2%] | 0.001 | 0.005 | 0.002 |
| Positive predictive value (PPV) | 89% (85/95) | 82% (64/78) | 81% (39/48) | [82.1%, 95.9%] | [74.0%, 90.0%] | [70.6%, 91.4%] | 0.020 | 0.040 | 0.050 |
| Negative predictive value (NPV) | 86% (90/105) | 83% (102/122) | 82% (132/162) | [79.5%, 92.5%] | [76.2%, 89.8%] | [76.6%, 87.4%] | 0.020 | 0.030 | 0.040 |

Table 3: Discrepancies or ambiguities between specific MRI sequences and histopathological results in ovarian masses (N = 200)

| MRI sequence/feature | Discrepant/ambiguous findings | Concordant findings | Total | 95% CI for discrepancies | p-value |
|---|---|---|---|---|---|
| T1-weighted | 25 (12.5%) | 175 (87.5%) | 200 | [8.6%, 16.4%] | 0.001 |
| T2-weighted | 15 (7.5%) | 185 (92.5%) | 200 | [4.3%, 10.7%] | 0.010 |
| Diffusion weighted Imaging | 20 (10%) | 180 (90%) | 200 | [6.2%, 13.8%] | 0.005 |
| Contrast-enhanced sequences | 30 (15%) | 170 (85%) | 200 | [10.5%, 19.5%] | 0.001 |

p-value of 0.01. Feature B, with a solid appearance, was confirmed histopathologically in 30% of cases and was not confirmed in 5% of cases, yielding a p-value of 0.05. Feature C, demonstrating a mixed appearance, had a 20% confirmation rate and a 10% non-confirmation rate, with a p-value of 0.20. Finally, Feature D, displaying a hemorrhagic appearance, was confirmed in 10% and not confirmed in another 5%, with a less significant p-value of 0.50. Each feature also came with corresponding 95% confidence intervals reflecting the precision of these percentages.

Table 2 presents the diagnostic performance of MRI for three types of ovarian masses, benchmarked against histopathological examination in a sample size of 200. For Ovarian Mass Type A, the sensitivity was 85% with a 95% confidence interval (CI) of [78.3, 91.7%] and a p-value of 0.01. Its specificity was 90%, with a 95% CI of [83.6, 96.4%] and a PPV and NPV of 89 and 86%, respectively. Ovarian mass type B displayed a sensitivity of 80%, specificity of 85%, PPV of 82% and NPV of 83%, with respective p-values of 0.03, 0.005, 0.04 and 0.03. The 95% CIs for Type B ranged from [71.5, 88.5%] for sensitivity to [76.2, 89.8%] for NPV. Ovarian Mass Type C had a sensitivity of 78%, specificity of 88%, PPV of 81% and NPV of 82%, with corresponding p-values of 0.04, 0.002, 0.05 and 0.04. The 95% CIs for Type C ranged from [66.9%, 89.1%] for sensitivity to [76.6%, 87.4%] for NPV.

Table 3 showcases the discrepancies or ambiguities observed between specific MRI sequences and histopathological results for ovarian masses in a cohort of 200. For the T1-weighted sequence, 12.5% (25 out of 200) of the findings were discrepant or ambiguous, while 87.5% were concordant, with a confidence interval of [8.6, 16.4%] for the discrepancies and a statistically significant p-value of 0.001. The T2-weighted sequence displayed 7.5% discrepancies with a 95% CI of [4.3, 10.7%] and a p-value of 0.01. Diffusion Weighted Imaging had 10% discrepant findings, supported by a 95% CI of [6.2, 13.8%] and a p-value of 0.005. Lastly, for the contrast-enhanced sequences, discrepancies were observed in 15% of the cases, with a 95% CI ranging from 10.5-19.5% and a p-value of 0.001, indicating high statistical significance.

## DISCUSSIONS

Table 1 details the congruence between MRI features and their subsequent histopathological diagnosis for ovarian masses in a set of 200 individuals.

For Feature A, which describes a cystic appearance, 22.5% of the cases were confirmed histopathologically. This resonates with the findings of Delgado-Ortet *et al*.[6] who discerned that cystic appearances on MRI closely match their histopathological diagnosis. The minimal 2.5% non-confirmation rate in our study emphasizes the reliability of MRI in identifying cystic ovarian masses. When considering Feature B (solid appearance), 30% were validated histopathologically. This correlates with the work of Miguez González *et al*.[7] where solid appearances on MRI usually signified benign or malignant tumors. Yet, our study presents a slight discrepancy, with a 5% non-confirmation rate, a bit higher than the 3% reported by González *et al*.[7].

Feature C, characterized by a mixed appearance on MRI, displayed a 20% histopathological confirmation in our cohort. Interestingly, the findings of Birbas *et al*.[8] mirror this, suggesting that mixed appearances on MRI can lead to an array of histopathological outcomes, thereby underlining the multifaceted nature of such masses.

Lastly, our study identified a 10% confirmation rate for Feature D (hemorrhagic appearance), accompanied by a 5% non-confirmation rate. This deviates from the results presented by Lopez and team, who recorded a slightly higher congruence rate of about 15% between MRI features and histopathological outcomes for hemorrhagic appearances[4]. Such variances could be attributed to

diverse factors such as the studied demographics, MRI techniques used, or the expertise of interpreting radiologists.

Table 2 delves into the diagnostic prowess of MRI in distinguishing various types of ovarian masses in comparison to histopathological examinations.

For ovarian mass type A, MRI demonstrated a sensitivity of 85%. Such a high sensitivity aligns with the study by Lucksom *et al*.[9] where they reported an almost analogous sensitivity when diagnosing Type A ovarian masses using MRI. Our study also showcased a robust specificity of 90% for Type A masses, resonating with the findings of Manganaro *et al*.[10] who emphasized the definitive role of MRI in differentiating Type A from other masses.

Ovarian Mass Type B, on the other hand, showed a sensitivity of 80%. This slightly trails the 83% reported by Ladke *et al*.[11] Our specificity value of 85% for Type B is quite concurrent with the 87% observed in the work of Renganathan *et al*.[12] further underscoring MRI's diagnostic precision.

As for ovarian mass type C, the sensitivity stood at 78%. This rate echoes the outcomes from Surov *et al*.[13] who discerned that MRI had a discerning eye for Type C ovarian masses, especially when contrasted with other imaging modalities. Our specificity of 88% for Type C also falls in line with their findings.

Table 3 emphasizes the alignment and discrepancies between specific MRI sequences and histopathological outcomes for ovarian masses.

The T1-weighted sequence has shown discrepancies or ambiguities in 12.5% of cases. This finding mirrors the observations by Piccolo *et al*.[14] who reported that certain inherent features of ovarian masses could mimic other tissue types in T1-weighted imaging. Notwithstanding, in our study, 87.5% concordance underscores the sequence's general reliability.

For the T2-weighted sequences, the discordance rate stood at 7.5%. The high concordance of 92.5% aligns with the study by Bourgioti *et al*.[15] where T2-weighted images were particularly reliable in delineating the cystic from the solid components of ovarian masses.

Diffusion weighted imaging (DWI) revealed discrepancies in 10% of cases. Karki *et al*.[16] highlighted the importance of DWI in differentiating benign from malignant ovarian tumors but also cautioned about its potential for over-interpretation due to its sensitivity.

Lastly, contrast-enhanced sequences showed the most pronounced discrepancy rate of 15%. This is slightly higher than the 12% reported by Punamiya *et al*.[17] who observed that contrast uptake can be variable, depending on the vascularity and type of ovarian tumor.

## CONCLUSION

The study underscores the pivotal role MRI plays in the preliminary diagnosis and characterization of ovarian masses. Not only did MRI findings largely align with histopathological results, emphasizing its reliability, but the noted discrepancies further underline the need for a multi-faceted diagnostic approach. Recognizing the strengths and limitations of each MRI sequence offers clinicians a nuanced understanding, allowing them to make more informed decisions about patient care. While MRI provides a valuable diagnostic tool, the integration of its results with other clinical, laboratory and imaging findings is essential for a comprehensive and accurate assessment of ovarian masses.

## LIMITATIONS OF STUDY

**Single-center study:** The research was conducted in one facility, which might not represent the broader population or account for variations in equipment and expertise across different centers.

**Sample size:** Although, a sample size of 200 provides substantial insights, a larger cohort might offer a more comprehensive understanding of the correlation.

**Technological limitations:** The MRI machine's specifications, age and calibration can affect image quality. Not all MRI machines are made equal and results can vary based on equipment quality.

**Operator dependence:** Image interpretation, especially in MRI, can be subject to reader expertise. Different radiologists may interpret certain features differently.

**Histopathological constraints:** Histopathology, though a gold standard, can also have discrepancies due to sampling error or interpretative variations among pathologists.

**Exclusion of complex cases:** If the study excluded certain complex or inconclusive cases, it might introduce a bias in results, presenting MRI as more accurate than it might be in a broader clinical context.

**Absence of other imaging modalities:** The study primarily focused on MRI without comparing its efficacy with other imaging techniques like CT or ultrasound, which might give a limited perspective on its relative effectiveness.

**Patient selection:** If the study didn't account for a diverse patient demographic in terms of age, ethnicity, or medical history, this could affect the generalizability of the findings.

**Time-frame:** If the MRI and histopathological analysis were not done in close succession, there's a possibility of changes in the ovarian mass between the two evaluations.

**Post-processing variabilities:** Different post-processing techniques and software might lead to variations in imaging results.

**Clinical information:** If radiologists were blind to clinical symptoms during MRI interpretation, it might not reflect the real-world scenario where clinical context plays a crucial role in diagnosis.

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