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Original Article

# Comparative Diagnostic Performance of Ultrasound and Magnetic Resonance Imaging in the Characterization of Adnexal Masses: A Prospective Study

**[1]Dr. Ankush Soni*, [2]Rajesh Kumar**

[1,2] Department of Radiology & imaging Technology, Krishna School of Health Sciences, Samastipur, India

***Corresponding Author:** Dr. Ankush Soni, Sr. Radiologist, Department of Radiology & imaging Technology, Krishna School of Health Sciences, Samastipur, India

**Email:** dah.rd89@gmail.com

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**ABSTRACT**

**Background:** Accurate characterization of adnexal masses is essential for appropriate management. Ultrasound is the primary imaging modality, while magnetic resonance imaging (MRI) provides additional tissue and morphological characterization. This study compared the diagnostic performance of ultrasound and MRI using histopathology as the reference standard.
**Materials and Methods:** This prospective study included 48 women aged 20–65 years with adnexal masses, conducted between March and June 2026. All patients underwent transabdominal and transvaginal ultrasound with Doppler assessment using the IOTA Simple Rules and ADNEX model, followed by pelvic MRI on 1.5-T or 3-T scanners. Histopathological examination of surgically excised or biopsied lesions served as the reference standard. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), accuracy, and Cohen's kappa were calculated.
**Results**: Histopathology identified 20 (41.7%) benign and 28 (58.3%) malignant lesions. Ultrasound showed 78.6% sensitivity, 85.0% specificity, 88.5% PPV, 73.3% NPV, and 81.3% accuracy. MRI demonstrated 89.3% sensitivity, 95.0% specificity, 96.2% PPV, 84.1% NPV, and 89.6% accuracy. MRI showed significantly higher diagnostic accuracy ($p$ = 0.045). Agreement with histopathology was substantial for ultrasound ($\kappa = 0.76$) and almost perfect for MRI ($\kappa = 0.89$).
**Conclusion**: MRI demonstrated superior diagnostic performance and provided valuable additional characterization of complex adnexal masses, while ultrasound remains an effective first-line modality.

**Keywords:** Adnexal Masses, Ultrasound, Magnetic Resonance Imaging, Histopathology Diagnostic Accuracy

## INTRODUCTION

Adnexal masses are a common clinical challenge encountered in gynecology, often detected incidentally or during evaluation of symptoms such as pelvic pain, abnormal bleeding, or palpable masses. Accurate characterization of these masses is crucial for determining appropriate management, including the need for surgical intervention versus conservative observation. The primary goal is to distinguish benign from malignant lesions to optimize patient outcomes and avoid unnecessary surgeries or delayed cancer treatment. [1] Ultrasound (US) remains the first-line imaging modality for evaluating adnexal masses due to its widespread availability, cost-effectiveness, and lack of ionizing radiation. It provides valuable morphological information, such as size, composition (solid, cystic, or complex), septations, and vascularity when combined with Doppler imaging. [2] However, ultrasound's diagnostic accuracy can be limited by operator dependency, patient body habitus, and the overlapping features of benign and malignant lesions, leading to potential misclassification. [3] Magnetic Resonance Imaging (MRI) has emerged as a complementary or alternative modality, offering superior soft tissue contrast and multiplanar capabilities. MRI can provide detailed tissue characterization, aiding in the differentiation of complex or indeterminate masses identified

on ultrasound. [4] Several studies have suggested that MRI improves diagnostic confidence and accuracy, especially in cases where ultrasound findings are inconclusive or equivocal. [5] Its ability to evaluate the lesion's internal architecture, enhancement patterns, and relation to adjacent structures enhances its utility in preoperative planning. [6]

Despite the increasing use of MRI, there remains ongoing debate regarding its incremental benefit over ultrasound, particularly considering cost and accessibility constraints. The diagnostic performance of both modalities can be quantitatively assessed by parameters such as sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy [7] These metrics are essential for understanding the reliability of each modality in correctly identifying malignant versus benign lesions. Previous research has demonstrated variable results regarding the comparative effectiveness of ultrasound and MRI. A meta-analysis by Wang et al. indicated that MRI had higher sensitivity and specificity than ultrasound in characterizing ovarian tumors, particularly in complex cases. [8] Conversely, other studies emphasize that high-quality ultrasound, especially when performed by experienced operators, can achieve diagnostic accuracy comparable to MRI in many scenarios. [9]

Factors influencing diagnostic performance include lesion size, patient age, symptomatology, and the specific imaging criteria used. [10] Prospective data are vital to establish evidence-based guidelines for employing ultrasound and MRI in routine clinical practice. In this context, a comprehensive evaluation involving the collection of demographic data, clinical presentation, imaging findings, and histopathological results is essential. Histopathology remains the gold standard for definitive diagnosis, serving as the reference point for assessing the accuracy of imaging modalities. The current study aims to prospectively compare the diagnostic accuracy of ultrasound and MRI in the characterization of adnexal masses. By analyzing sensitivity, specificity, PPV, NPV, and overall accuracy, this research seeks to delineate the roles of these imaging techniques and provide evidence to guide clinical decision-making. Such data are crucial for optimizing patient management, reducing unnecessary surgeries, and ensuring timely intervention for malignant lesions.

## MATERILS AND METHODS

**Study Design and Setting**: This prospective study was carried out at tertiary healthcare institution, between 14/03/2026 and 13/6/2026. Prior approval was obtained from the Institutional Review Board, and all participants provided written informed consent before enrollment.

**Study Participants:** The study included 48 women aged between 20 and 65 years who presented with adnexal masses detected either clinically or incidentally during routine examinations. Inclusion criteria required that patients be candidates for surgical intervention or biopsy, with available histopathological confirmation. Patients with contraindications to MRI, pregnant women, or those unable to undergo imaging procedures were excluded from the study.

**Ultrasound Imaging Procedure**: All subjects underwent comprehensive ultrasound examinations performed by experienced radiologists using high-resolution ultrasound machines. Both transabdominal and transvaginal approaches were utilized to assess the adnexal lesions. The ultrasound assessment focused on determining lesion size, shape, internal structure, septations, papillary projections, echogenicity, and vascularity using Doppler imaging. The IOTA simple rules and ADNEX model were applied to categorize each lesion as benign or malignant.

**Magnetic Resonance Imaging Protocol**: MRI scans were performed on 1.5 Tesla or 3 Tesla scanners with a dedicated pelvic coil. The imaging protocol included T1-weighted, T2-weighted, fat-suppressed sequences, and dynamic contrast-enhanced imaging. Radiologists, blinded to ultrasound findings, evaluated the MRI images to analyze lesion characteristics such as internal composition, signal intensity, enhancement patterns, and relation to surrounding tissues. Lesions were classified based on morphological features suggestive of benignity or malignancy.

**Histopathological Examination**: Following imaging, all patients underwent surgical removal or biopsy of the ovarian or adnexal masses. The excised tissues were examined by pathologists to establish a definitive diagnosis, which served as the reference standard. The histopathological results categorized the lesions into benign or malignant groups.

**Data Analysis**: Data were compiled and analyzed using SPSS Software, calculating diagnostic accuracy metrics, including sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracyfor both ultrasound and MRI. These metrics were compared statistically using appropriate tests such as the McNemar test, with a significance threshold set at $p < 0.05$.

## RESULTS

A total of 48 women were included in the study, with a mean age of 42.3 ± 10.5 years (range, 20–65 years). Thirty participants (62.5%) were premenopausal and 18 (37.5%) were postmenopausal. Histopathological examination identified 20 lesions (41.7%) as benign and

28 (58.3%) as malignant. Lesion size ranged from 2 to 12 cm, with a mean size of 6.4 ± 2.8 cm (Figure 1).

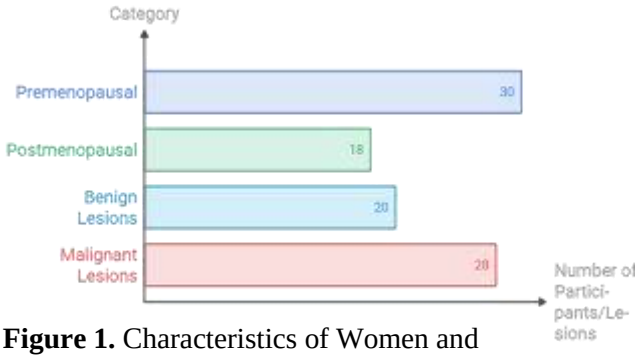



**Figure 1.** Characteristics of Women and Lesions in the Study

**Diagnostic Performance of Ultrasound and MRI:** Ultrasound correctly identified 22 of 28 malignant lesions and 17 of 20 benign lesions. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were 78.6%, 85.0%, 88.5%, and 73.3%, respectively. The overall diagnostic accuracy was 81.3% (39/48) (Figure 2).

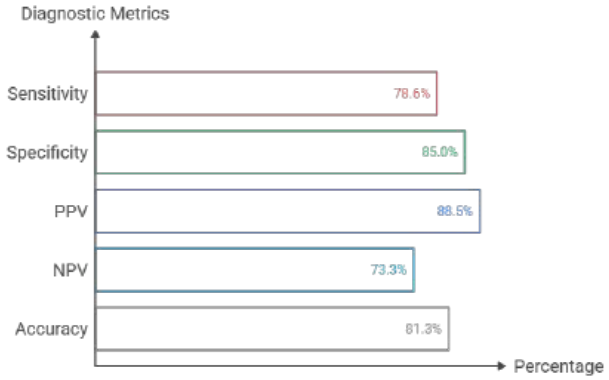



**Figure 2.** Performance Metrics of Ultrasound in Lesion Diagnosis

MRI demonstrated higher diagnostic performance in Figure 3, correctly identifying 25 of 28 malignant lesions and 19 of 20 benign lesions. The reported sensitivity was 89.3%, specificity 95.0%, PPV 96.2%, and NPV 84.1%, with an overall reported diagnostic accuracy of 89.6% (43/48).

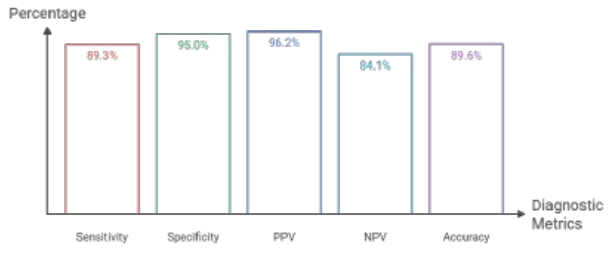



**Figure 3.** MRI Diagnostic Performance Metrics

**Table 1.** Diagnostic performance of ultrasound and MRI for characterization of adnexal lesions

| Parameter | Ultrasound | MRI |
|---|---|---|
| Sensitivity | 78.6% (22/28) | 89.3% (25/28) |
| Specificity | 85.0% (17/20) | 95.0% (19/20) |
| Positive predictive value | 88.5% (22/25) | 96.2% (25/26) |
| Negative predictive value | 73.3% (17/23) | 84.1% (19/22) |
| Overall accuracy | 81.3% (39/48) | 89.6% (43/48) |

**Comparative Diagnostic Performance:** MRI demonstrated a higher overall diagnostic accuracy than ultrasound (89.6% vs. 81.3%), and the difference was statistically significant (McNemar test, $p = 0.045$). MRI also demonstrated higher sensitivity and specificity than ultrasound, with the reported differences reaching statistical significance ($p < 0.05$). Agreement with histopathological diagnosis was substantial for ultrasound (Cohen's $\kappa = 0.76$) and almost perfect for MRI (Cohen's $\kappa = 0.89$).

**Table 2.** Comparison of ultrasound and MRI according to diagnostic accuracy and agreement with histopathology

| Measure | Ultrasound | MRI |
|---|---|---|
| Overall accuracy | 81.3% | 89.6% |
| Sensitivity | 78.6% | 89.3% |
| Specificity | 85.0% | 95.0% |
| Cohen's κ | 0.76 | 0.89 |
| Agreement with histopathology | Substantial | Almost perfect |

**Imaging Findings:** Ultrasound demonstrated characteristic benign morphological features, including well-defined anechoic cystic morphology and posterior acoustic enhancement. MRI provided more detailed assessment of lesion morphology and internal architecture, including septations and enhancement characteristics. Representative imaging findings are presented in **Figures 5 (A & B)**.

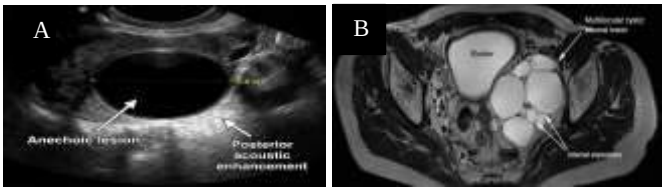



**Figure 5**. [A] Ultrasound of a benign anechoic ovarian cyst with posterior acoustic enhancement. [B] T2-weighted MRI of a benign multilocular adnexal cyst with internal septations.

## DISCUSSION

The present study evaluated the diagnostic performance of ultrasound and magnetic resonance imaging (MRI) in the characterization of adnexal masses using histopathology as the reference standard. MRI demonstrated higher diagnostic performance than ultrasound, with an overall accuracy of 89.6% compared with 81.3% for ultrasound. MRI also showed higher sensitivity (89.3%) and specificity (95.0%) than ultrasound (78.6% and 85.0%, respectively). The difference in overall diagnostic accuracy was statistically significant (McNemar test, $p = 0.045$). Ultrasound remains an important first-line modality because of its accessibility, low cost, absence of ionizing radiation, and ability to assess lesion morphology and vascularity. In the present study, ultrasound correctly identified 22 of 28 malignant lesions and 17 of 20 benign lesions. However, complex adnexal lesions may demonstrate overlapping benign and malignant morphological features, limiting diagnostic confidence.

MRI provided more detailed evaluation of lesion composition, internal architecture, signal characteristics, enhancement patterns, and relationships with surrounding structures. The representative T2-weighted MRI image demonstrates a multilocular cystic adnexal lesion with internal septations and predominantly fluid signal characteristics, illustrating the ability of MRI to clearly depict complex internal morphology. Such detailed characterization can assist in differentiating lesions with benign-appearing features from those requiring further evaluation. The higher agreement of MRI with histopathology, reflected by a Cohen's kappa of 0.89 compared with 0.76 for ultrasound, further supports its role as a useful problem-solving modality for indeterminate adnexal masses.

## CONCLUSION

MRI demonstrated higher diagnostic accuracy than ultrasound in the characterization of adnexal masses, with better sensitivity and specificity. Ultrasound remains useful as a first-line imaging modality, while MRI provides additional morphological and tissue characterization, particularly in complex lesions. The findings support the complementary use of both modalities, with histopathology remaining the definitive method for diagnosis.

## DECLARATIONS

**Ethics Approval and Consent to Participate:** Institutional Ethics Committee approval was obtained for this study.

**Consent for Publication:** Not applicable.

**Availability of Data and Materials:** The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

**Competing Interests:** The authors declare that there are no competing interests regarding the publication of this article.

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