Journal of Karnali Academy of Health Sciences
An Official Journal of Karnali Academy of Health Sciences

Diagnostic accuracy of MRI in the evaluation of adnexal masses using histopathology as the gold standard in a tertiary hospital of central Nepal

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ABSTRACT

Introduction: Adnexal masses represent broad spectrum of gynecological conditions, ranging from benign cysts to malignant ovarian tumors. Accurate diagnosis and characterization are critical for clinical decision-making, including surgical planning, fertility preservation, and oncological referral. Magnetic Resonance Imaging (MRI), with superior soft-tissue contrast, multiplanar capability, and functional imaging techniques, offers improved characterization of adnexal masses. The objective of this study was to evaluate the diagnostic role of MRI in detecting and characterizing adnexal masses.

Methods: A hospital-based prospective cross-sectional study was conducted among 80 female patients with adnexal masses identified on USG at the Department of Radiology, College of Medical Sciences and Teaching Hospital, Bharatpur, Chitwan, Nepal. This study was conducted between September 2024 to October, 2025. All patients went MRI evaluation followed by surgical excision and histopathological performance using (sensitivity, specificity, PPV and NPV) of MRI taking histopathology as gold standard. Data were entered and analyzed using SPSS-20. P-value<0.05 was considered as statistically significant.

Results: The mean±SD of age was 38.42±6.28 years. Most patients (25%) were in 30-39 years with 62.5% premenopausal. Histopathology revealed 68.8% benign and 31.2% malignant lesions. MRI demonstrated sensitivity 85%, specificity 72%, PPV 78%, NPV 80%, and overall accuracy 77.5%. Restricted diffusion, solid components, peritoneal deposits, and contrast enhancement were significantly associated with the Adnexal masses ($p < 0.05$).

Conclusion: MRI is reliable imaging modality for differentiating benign from malignant adnexal masses, identifying key imaging markers, and guiding clinical management. Integration of MRI into diagnostic pathways improves patient care and reduces unnecessary interventions.

Keywords: Adnexal Mass, Diagnostic Accuracy, Histopathology, MRI, Ovarian Tumor

INTRODUCTION

Adnexal masses are a broad spectrum of gynecological conditions ranging from benign cysts to malignant ovarian tumors. Accurate diagnosis and characterization of these masses are essential, as they affect clinical management decisions- like the need for surgery, fertility preservation, and oncological referral.[1] Ultrasound (USG), particularly transvaginal ultrasound, is 1st line imaging modality due to its accessibility and cost-effectiveness. It has limitations in complex or indeterminate cases, especially when the lesion shows atypical morphology or arises in patients with obesity, bowel gas interference, or equivocal sonographic findings.[2] Magnetic Resonance Imaging (MRI) is a powerful diagnostic tool in such scenarios. With its excellent soft-tissue contrast resolution, multiplanar capability, and lack of ionizing radiation, MRI enables detailed assessment of adnexal masses and their relationships with adjacent pelvic structures.[3] It helps differentiate benign from malignant lesions, characterize indeterminate adnexal masses, and stage ovarian and adnexal malignancies. Advanced MRI techniques like diffusion-weighted imaging (DWI), dynamic contrast-enhanced (DCE) imaging, and apparent diffusion coefficient (ADC) mapping, provide functional information that complements morphologic evaluation, improving diagnostic accuracy.[4] Although MRI is well established for evaluating adnexal masses, most supporting evidence comes from settings with different patient profiles and healthcare resources. There is limited local data from Nepal validating MRI findings against histopathology in routine clinical practice. This study provides context-specific evidence on the diagnostic accuracy of MRI in a tertiary care hospital of Central Nepal, supporting more informed preoperative decision-making and appropriate use of MRI in similar resource-limited settings.

METHODS

This prospective hospital-based cross-sectional study was conducted in the Departments of Radiology at the College of Medical Sciences and Teaching Hospital, Bharatpur-10, Chitwan, Nepal, from September 2024 to October 2025. Ethical approval was taken from the Institutional Review Committee (IRC) of College of Medical Sciences and Teaching Hospital (COMSTH) (Ref No. : COMSTHIRC/2023-123-60). Informed written consent was obtained from 80 patients before data collection, and the confidentiality of patient information was strictly maintained throughout the study. This study included all female patients presenting with adnexal masses detected on USG and referred for MRI evaluation. The study population consisted of 80 female patients of all age groups who met the inclusion criteria. Patients were included if they had an adnexal mass identified on ultrasound, were willing to undergo MRI, and subsequently underwent surgical excision with histopathological confirmation, which served as the gold standard for diagnosis. Patients with contraindications to MRI (pacemakers, metallic implants, and severe claustrophobia), pregnant women, and those who did not undergo surgery or histopathology were excluded from the study.

Demographic and clinical information, including age, menopausal status, and presenting symptoms such as abdominal pain, abdominal distension, palpable abdominal mass, and menstrual irregularities, was collected through patient interviews and medical record review. MRI was performed on a 1.5-Tesla scanner (Siemens Magnetom Avanto,

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Date of Submission: November 9, 2025
Date of Acceptance: January 1, 2026
Date of Publication: January 10, 2026

DOI: https://doi.org/10.61814/jkahs.v8i3.1147

Siemens Healthineers, Germany) using a standardized pelvic protocol, including T1- and T2-weighted images with and without fat suppression, DWI with ADC mapping, and dynamic contrast-enhanced sequences.4,8 MRI was used to assess adnexal masses for specific imaging features, including lesion morphology, presence of solid components, septal thickness, papillary projections, contrast enhancement patterns, diffusion restriction, ascites, and peritoneal deposits. Lesions were classified as malignant on MRI if they demonstrated one or more of the following features: predominantly solid or mixed solid–cystic components, thick or irregular septations (>3 mm), enhancing papillary projections or mural nodules, marked contrast enhancement, restricted diffusion with low ADC values, associated ascites, or peritoneal/omental deposits. Lesions were considered benign if they showed purely cystic morphology, thin smooth walls or septa (<3 mm), absence of solid enhancing components, no diffusion restriction, and no associated ascites or peritoneal disease. MRI-based classifications were subsequently compared with histopathological findings.

The diagnostic performance of MRI was evaluated through standard parameters, including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy. A 2×2 cross-tabulation of MRI findings versus histopathology was constructed to calculate these diagnostic metrics.

An adnexal mass was considered malignant on MRI if it demonstrated one or more of the following features: solid or predominantly solid enhancing components, thick or irregular septations, papillary projections or mural nodules with contrast enhancement, restricted diffusion with low ADC values, associated ascites, or evidence of peritoneal/omental deposits.

Data were coded and entered into Microsoft Excel and analyzed using SPSS version 20. Continuous variables, such as age, were expressed as mean ± standard deviation, while categorical variables, including MRI features and histopathological type, were presented as frequencies and percentages. The association between MRI findings and histopathological diagnosis was assessed using the Chi-square test for categorical variables. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 80 female patients with adnexal masses were included in this study. The participants' ages ranged from 18 to 75 years, with a mean±SD of 38.42±6.28 years. The majority of patients (25%) belonged to the 30–39-year age group, followed by 18–29 years (20%) and 40–49 years (20%). Regarding menopausal status, 50 (62.5%) women were premenopausal, while 30 (37.5%) were postmenopausal. The most common presenting symptom was abdominal pain, observed in 44 (55%) patients, followed by abdominal distension in 20 (25%), palpable abdominal mass in 12 (15%), and menstrual irregularity in 4 (5%) cases (Table 1).

Table 1: Clinicodemographic information of patients (n = 80)

Particulars	Frequency (%)
Age (years)	
18–29	16(20)
30–39	20(25)
40–49	16(20)
50–59	15(18.8)
≥60	13(16.2)
Mean±SD	38.42±6.28 years
Menopausal Status	
Premenopausal	50(62.5)
Postmenopausal	30(37.5)
Presenting Symptoms	
Abdominal pain	44(55)
Abdominal distension	20(25)
Palpable mass	12(15)
Menstrual irregularity	4(5)

Histopathological examination confirmed that the majority of adnexal masses were benign, accounting for 55 (68.8%) cases, whereas 25 (31.2%) cases were malignant.

Restricted diffusion was observed in 18 (72%) malignant masses and 6 (10.9%) benign masses. The association between restricted diffusion and the type of adnexal mass was found to be statistically significant (χ^2-value=30.545, p-value <0.001). Among 25 malignant cases, 7 (28%) had peritoneal deposits, whereas 18 (72%) had none. In contrast, among 55 benign lesions, only 1 (1.8%) case demonstrated peritoneal deposits, and 54 (98.2%) had none. Peritoneal deposits were found to have a statistically significant association with malignant adnexal masses (χ^2-value=13.091, p-value =0.003). Among 25 malignant cases, 16 (64%) had solid components, while 9 (36%) did not. In contrast, only 5 (9.1%) of 55 benign lesions demonstrated solid components, with the majority 50 (90.9%) showing purely cystic or septated morphology. Solid components on MRI were significantly associated with malignant adnexal masses (χ^2-value=26.768, p-value <0.001). (Table 2).

Table 2: Association between restricted diffusion, peritoneal deposits, solid components and contrast enhancement with type of mass

Variables	Type of Mass n(%)		*Chi-square/ **Fisher's exact test	p-value
	Malignant	Benign		
Restricted diffusion				
Present	18 (72)	6(10.9)	30.545*	<0.001
Absent	7(28)	49(89.09)		
Peritoneal deposits				
Present	7(28)	1(1.8)	13.091**	0.003
Absent	18(72)	54(98.2)		
Solid components				
Present	16(64)	5(9.1)	26.768**	<0.001
Absent	9(36)	50(90.9)		

MRI correctly identified 21 of 25 malignant masses (true positives) and 40 of 55 benign masses (true negatives). Four malignant masses were misdiagnosed as benign (false negatives), and 15 benign masses were misdiagnosed as malignant (false positives). MRI demonstrated high sensitivity (85%) and good specificity (72%), with an overall diagnostic accuracy of 77.5%, confirming its value in differentiating benign from malignant adnexal masses. There is a significant association between MRI diagnosis and Histopathology diagnosis (2-value=32.347, p-value <0.001) (Table 3).

Table 3: Diagnostic performance of MRI in differentiating benign and malignant adnexal masses compared with histopathological findings (n = 80)

MRI Diagnosis	Malignant (Histopathology)	Benign (Histopathology)	Total
Malignant	21 (TP)	15 (FP)	36
Benign	4 (FN)	40 (TN)	44
Total	25	55	80

Sensitivity was found to be 85%, Specificity as 72%, Positive Predictive Value (PPV) as 78%, Negative Predictive Value (NPV) as 80% and Overall Accuracy was found to be 77.5%.

DISCUSSION

The present study was conducted among 80 patients with adnexal masses. Among all patients, the mean ± SD was 38.42 ± 6.28 years, with an age range from 18 to 75 years. Most patients (25%) were aged 30–39 years, followed by 18–29 years (20%) and 40–49 years (20%). In a study by Al-Shukri et al., the mean age is mentioned as 28 years.[5] Aadnexal masses were most prevalent in women of the reproductive

age group.[6] Among all, 62.5% patients were premenopausal, while 37.5% were postmenopausal. This study found that the most common presenting symptom was abdominal pain (55%), followed by abdominal distension (25%), palpable mass (15%), and menstrual irregularity (5%). Subramanyam et al. found that the most frequent presenting symptoms among patients with adnexal masses were lower abdominal pain (88%) and a palpable lump in the lower abdomen (32%).[1] Abdalla et al. reported abdominal pain in 77.5% of cases, vaginal bleeding in 20%, and asymptomatic presentation in 12.5% of patients.[7] Although ultrasound is less effective at determining the exact origin of a mass, it remains an essential initial tool for detecting adnexal masses. However, MRI provides superior accuracy in tissue characterization.[8]

MRI demonstrated high sensitivity (85%) and 72% specificity, with an overall diagnostic accuracy of 77.5%, confirming its value in differentiating benign from malignant adnexal masses. There is a statistically significant association between MRI diagnosis and Histopathology diagnosis (chi-square value=32.347, p-value <0.001).

The relatively lower sensitivity and specificity observed in this study compared with previously published reports may be attributed to several factors, including a small sample size, a higher proportion of benign cystic lesions with wall or septal enhancement that can mimic malignancy, and overlap in MRI features between complex benign and malignant adnexal masses. In addition, variability in lesion morphology at presentation, a broad definition of contrast enhancement, and real-world imaging constraints in a resource-limited setting may have influenced diagnostic performance. These factors likely contributed to reduced discrimination between benign and malignant lesions on MRI.

Likewise, Subramanyam et al. found that MRI showed 100% sensitivity and 97.7% specificity in the detection and characterization of adnexal masses, indicating its high diagnostic accuracy.[1] Similarly, a study by Aslam Sohaib et al. reported an MRI sensitivity of 95% and a specificity of 88% for the characterization of adnexal masses.[6] A meta-analysis by Kinkel et al. reported that MRI had a sensitivity of 100% and specificity of 94% for diagnosing malignancy in indeterminate adnexal masses. MRI is highly effective in confidently diagnosing many common benign adnexal lesions. Thus, women with indeterminate pelvic masses on ultrasound but a low clinical risk of malignancy are most likely to benefit from MRI.[9] In a study by Guerra et al., MRI demonstrated a sensitivity of 98% and specificity of 93% for detecting malignancy.[10] In a study by Madan MK et al., the sensitivity of grayscale USG for detecting adnexal masses was 92.5%, which is higher than the 80% sensitivity observed in our study.[11]

A study published in the Journal of Clinical Imaging Science reported that MRI had a sensitivity of 75% and a specificity of 100%, with an overall diagnostic accuracy of 91.43% compared with histopathology.[12] Similarly, another study in the Journal of Clinical and Diagnostic Research found MRI sensitivity and specificity to be 95% and 94.37%, respectively, with a diagnostic accuracy of 94.7%.[13] Furthermore, Avesani et al.[14] in the ESR Essentials series, reviewed the role of MRI in the evaluation of adnexal masses, providing standardized recommendations for imaging protocols and interpretation. The study emphasized MRI's high diagnostic accuracy in distinguishing benign from malignant lesions, its complementary role to ultrasound, and its value in guiding clinical and surgical decision-making. Several studies have demonstrated that MRI serves as a valuable problem-solving modality for identifying the origin of pelvic masses and characterizing adnexal lesions, especially in cases with ambiguous clinical findings. Moreover, MRI is effective in detecting local invasion as well.[15,16] Saroja Adusumilli et al.,[8] reported that MRI demonstrated a sensitivity of 100% in identifying adnexal masses and a specificity of 94% for detecting benign lesions. Their study showed an excellent agreement between MRI findings and the final diagnosis in determining the origin ($\kappa = 0.93$), tissue content ($\kappa = 0.98$), and tissue characteristics ($\kappa = 0.91$) of the masses. In contrast, ultrasonography exhibited poor agreement with the final diagnosis regarding the origin ($\kappa = 0.19$) and tissue content ($\kappa = 0.33$) of the masses.

MRI offers several advantages over ultrasound in the evaluation of adnexal masses. It provides superior soft-tissue contrast, allowing better characterization of solid, cystic, and complex components, as well as septations, papillary projections, and mural nodules. MRI can detect peritoneal deposits, ascites, and local invasion more accurately than ultrasound, which is limited by operator dependence, patient body habitus, and bowel gas. Furthermore, diffusion-weighted imaging (DWI) and ADC mapping, along with dynamic contrast enhancement, allow MRI to differentiate benign from malignant lesions with higher reliability, particularly in complex or indeterminate adnexal masses where ultrasound findings are inconclusive.

Our research showed that MRI had high sensitivity (85%) and good specificity (72%), with an overall diagnostic accuracy of 77.5%, confirming its value in differentiating benign from malignant adnexal masses. There is a significant association between MRI diagnosis and Histopathology diagnosis (χ^2-value = 32.347, p-value <0.001). A study conducted by AWAIS et al. found the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy of MRI in detecting adnexal masses as 95%, 94.37%, 94.37%, and 94.7%, respectively, when compared to histopathology as the gold standard.[17]

Some benign lesions in our study might be misclassified as malignant, primarily due to diffusion restriction and contrast enhancement seen in benign conditions such as endometriomas, hemorrhagic cysts, or inflammatory masses. Technical factors like motion artifacts, suboptimal fat suppression, and timing of contrast imaging may also contribute to false positives. The unusual finding of many malignant masses appearing non-enhancing likely reflects that enhancement was recorded throughout the lesion, including cyst walls or septa, rather than only solid components. Solid components, peritoneal deposits, diffusion restriction, and enhancement patterns remain key parameters for differentiating benign from malignant adnexal masses, but their interpretation should consider lesion composition and technical limitations.

This was a single-center, hospital-based study with a relatively small sample size, which may limit generalizability. Technical factors and the method of contrast enhancement could have affected diagnostic accuracy.

CONCLUSION

MRI plays a vital role in the diagnosis and characterization of adnexal masses, offering high sensitivity, specificity, and overall diagnostic accuracy. MRI is particularly valuable for differentiating benign from malignant lesions and for identifying key imaging features, such as restricted diffusion, solid components, peritoneal deposits, contrast enhancement, and ascites, which are significantly associated with malignancy. By providing detailed morphologic and functional information, MRI guides clinical management, aids surgical planning, and supports decisions on fertility preservation and oncologic referral. Its integration into routine evaluation improves diagnostic confidence, reduces unnecessary surgery for benign lesions, and ensures timely intervention for malignant cases, making MRI an essential tool in tertiary care settings.

DECLARATION

Acknowledgement

The authors extend their heartfelt gratitude to the nurses and the residents of the Department of Radiology for their invaluable assistance in data collection for this research. We deeply appreciate their time, effort, and significant contributions, which were instrumental in the successful completion of this study.

Authors' contributions

Prasad V.P. contributed to the concept, study design, intellectual content, literature review, data acquisition, manuscript preparation, editing, and finalization. The residents of the Department of Radiology assisted in the literature search, data collection, data analysis, interpretation, manuscript review, editing, and finalization.

Ethical Approval

Ethical approval was taken from the Institutional Review Committee (IRC) of College of Medical Sciences and Teaching Hospital (COMSTH) (Ref No.: COMSTHIRC/2023-123-60).

Consent/Assent

Informed written consent was obtained from 80 patients before data collection, and the confidentiality of patient information was strictly maintained throughout the study.

Data Availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflict of interest

None

Source of funding

None

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