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Original Research Article

Diagnostic accuracy of magnetic resonance imaging in the preoperative characterization of ovarian neoplasms: a retrospective study with histopathological correlation

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ABSTRACT

Background: To evaluate the diagnostic accuracy of magnetic resonance imaging (MRI) in the preoperative characterization of ovarian neoplasms using histopathological examination (HPE) as the reference standard.
Methods: This retrospective observational study included 105 women with indeterminate or suspicious adnexal masses who underwent preoperative MRI followed by surgical management and histopathological examination at a tertiary care centre. MRI findings were categorized as benign or borderline/malignant based on morphological and tissue-specific imaging characteristics. Histopathological examination served as the reference standard. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), overall diagnostic accuracy, and Cohen's kappa coefficient were calculated.
Results: Histopathological examination identified 73 (69.5%) benign and 32 (30.5%) borderline/malignant ovarian neoplasms. MRI correctly classified all 73 benign lesions and 27 of the 32 borderline/malignant lesions, while five borderline/malignant lesions were incorrectly classified as benign. MRI demonstrated a sensitivity of 84.4%, specificity of 100%, PPV of 100%, NPV of 93.6%, and overall diagnostic accuracy of 95.2%. Agreement between MRI and histopathological classification was excellent (κ=0.88).
Conclusion: MRI demonstrated high diagnostic accuracy and excellent agreement with histopathological examination in differentiating benign from borderline/malignant ovarian neoplasms. Its high specificity supports its role as a valuable problem-solving modality in the preoperative characterization of ovarian masses. However, histopathological examination remains essential for definitive diagnosis.

Keywords: Ovarian neoplasms, Magnetic resonance imaging, Histopathology, Adnexal mass, Diagnostic accuracy, O-RADS MRI

INTRODUCTION

Ovarian neoplasms comprise a heterogeneous group of benign, borderline, and malignant tumours arising from different cellular components of the ovary. Although the majority of ovarian tumours are benign, ovarian cancer remains one of the most lethal gynaecological malignancies, largely because of its nonspecific clinical presentation and frequent diagnosis at an advanced stage. Accurate preoperative characterization of ovarian masses is therefore important for appropriate patient triage, surgical planning, fertility preservation when feasible, and timely referral to gynaecologic oncology services.[1,2] Ultrasonography (USG) is the first-line imaging modality for the evaluation of adnexal masses because it is widely available, inexpensive, and allows detailed morphological and Doppler assessment. Standardized terminology and prediction models developed by the international ovarian

tumor analysis (IOTA) group have substantially improved sonographic characterization of adnexal lesions. Nevertheless, a proportion of adnexal masses remain indeterminate following ultrasonographic evaluation, particularly complex cystic and solid lesions.[3,4]

MRI is an important second-line imaging modality for sonographically indeterminate adnexal masses because of its superior soft-tissue contrast, multiplanar capability, and ability to characterize tissue components such as fat, haemorrhage, fibrous tissue and solid enhancing components. Diffusion-weighted imaging (DWI) and contrast-enhanced MRI provide additional information that may improve differentiation between benign and malignant lesions.[5,6]

Several studies have demonstrated the high diagnostic performance of MRI in the characterization of adnexal masses. Sohaib et al. demonstrated the value of MRI in differentiating benign from malignant adnexal lesions.[7] More recently, Thomassin-Naggara et al developed and validated the Ovarian-Adnexal Reporting Data System MRI (O-RADS MRI) score for risk stratification of sonographically indeterminate adnexal masses, demonstrating high sensitivity and specificity for the detection of malignancy.[8] A systematic review and meta-analysis by Wang et al further supported the high diagnostic performance of MRI in differentiating benign and malignant ovarian tumours.[9]

Previous studies have demonstrated high diagnostic accuracy of conventional, diffusion-weighted and multiparametric MRI in differentiating benign from borderline or malignant adnexal masses.[12-16] Despite advances in imaging, histopathological examination remains the definitive reference standard for diagnosis. Correlation between preoperative MRI findings and final histopathological diagnosis is therefore important in determining the diagnostic reliability of MRI in routine clinical practice. The present study was undertaken to evaluate the diagnostic accuracy of MRI in the preoperative characterization of ovarian neoplasms using histopathological examination as the reference standard.

Objectives

Primary objective

To evaluate the diagnostic accuracy of MRI in the preoperative characterization of ovarian neoplasms using HPE as the reference standard.

Secondary objectives

To determine the sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy of MRI in differentiating benign from borderline/malignant ovarian neoplasms.

To assess the agreement between MRI classification and final histopathological diagnosis. To evaluate the ability of MRI to characterize different ovarian neoplasms based on morphological and tissue-specific imaging features. To identify discordant cases between MRI and histopathological diagnosis.

METHODS

Study design and participants

This retrospective observational study was conducted in the Department of Obstetrics and Gynaecology, at Sri Madhusudan Sai Institute of Medical Sciences and Research, Chikkaballapur, Karnataka, India, over a two-year period (January 2024–January 2026).

Inclusion criteria

Women with an adnexal mass suspected to be of ovarian origin. Patients who underwent preoperative MRI followed by surgical management. Availability of a definitive postoperative histopathological diagnosis. Availability of complete clinical, radiological and histopathological records.

Exclusion criteria

Patients who did not undergo surgical management. Patients without histopathological confirmation. Patients with incomplete or unavailable MRI or clinical records. Patients with recurrent ovarian malignancy. Patients with metastatic tumours involving the ovary.

Clinical and imaging assessment

Demographic information, clinical findings, operative details, preoperative imaging findings and final histopathological diagnoses were retrieved from hospital medical records. Ultrasonography was performed as the initial imaging investigation. Patients with indeterminate or suspicious adnexal masses who subsequently underwent preoperative MRI, surgical management and histopathological examination were included.

MRI characteristics recorded included lesion size, laterality, morphology, cystic and solid components, wall and septal thickness, papillary projections, haemorrhagic or fatty components, diffusion restriction, contrast enhancement, ascites, lymphadenopathy and involvement of adjacent structures. Based on the documented MRI findings, lesions were classified as benign or borderline/malignant. The MRI classification was compared with the final histopathological diagnosis, which was considered the reference standard.

Histopathological examination

All patients underwent definitive surgical treatment, and the excised specimens were subjected to histopathological

examination, which served as the reference standard for diagnosis. Histopathological classification of ovarian neoplasms was performed according to the world health organization (WHO) classification of female genital tumours.

Ethical considerations

Formal institutional ethics committee approval was not obtained for this retrospective record-based study. The analysis was restricted to existing clinical, radiological and histopathological records generated during routine patient care. No patient was contacted, and no additional investigation or intervention was performed for the study. All data were anonymized before analysis, and patient confidentiality was maintained throughout the study.

Statistical analysis

Data were analysed using IBM SPSS Statistics version 29.0. Continuous variables were summarized using mean and standard deviation or median and interquartile range, as appropriate. Categorical variables were presented as frequencies and percentages. For the diagnostic-accuracy analysis, borderline and malignant neoplasms were grouped as a positive result, while benign neoplasms were considered a negative result. Histopathological examination was used as the reference standard. Sensitivity, specificity, positive predictive value, negative predictive value and overall diagnostic accuracy were calculated using a 2×2 contingency table. Agreement between MRI classification and histopathological diagnosis was assessed using Cohen's kappa coefficient. A p value of <0.05 was considered statistically significant.

RESULTS

A total of 105 women with suspected ovarian neoplasms who underwent preoperative MRI and subsequent HPE were included in the study. Histopathological examination served as the reference standard for diagnosis. A total of 105 women with suspected ovarian neoplasms who underwent preoperative magnetic resonance imaging and subsequent histopathological examination were included in the study. The mean age was 38.6±14.4 years, while the median age was 37 years, with an interquartile range of 28–47 years. Most participants were parous (75.2%). The demographic and clinical characteristics are summarized in Table 4.

Histopathological examination revealed 73 (69.5%) benign and 32 (30.5%) borderline/malignant ovarian neoplasms (Table 1). Benign lesions constituted the majority of cases in the study population. MRI correctly classified 100 of 105 lesions (95.2%). Of the 73 benign lesions confirmed on histopathology, all 73 were correctly classified as benign on MRI. Among the 32 borderline/malignant lesions on histopathology, 27 were correctly classified as malignant on MRI, while five were classified as benign. No histopathologically benign lesion was classified as malignant on MRI (Table 2). Using histopathological diagnosis as the reference standard, MRI demonstrated a sensitivity of 84.4%, specificity of 100%, positive predictive value (PPV) of 100%, negative predictive value (NPV) of 93.6%, and overall diagnostic accuracy of 95.2% for differentiating benign from borderline/malignant ovarian neoplasms. Agreement between MRI and histopathological classification was excellent (Cohen's κ=0.88) (Table 3).

Table 1: Histopathological distribution of ovarian neoplasms (n=105).

Histopathological diagnosis	N	%
Benign ovarian tumours	73	69.5
Borderline/malignant ovarian tumours	32	30.5
Total	105	100

Table 2: MRI–histopathology correlation.

MRI classification	HPE borderline/malignant	HPE benign	Total
Malignant	27	0	27
Benign	5	73	78
Total	32	73	105

Table 3: Diagnostic performance of MRI.

Parameter	Value
Sensitivity	84.4%
Specificity	100%
Positive predictive value (PPV)	100%
Negative predictive value (NPV)	93.6%
Diagnostic accuracy	95.2%
Cohen's kappa (κ)	0.88

Table 4: Characteristics.

Characteristics	Result
Mean age, years	38.6±14.4
Median age, years	37
Interquartile range	28–47
Age range (in years)	11–78
≤20	8 (7.6%)
21–30	26 (24.8%)
31–40	25 (23.8%)
41–50	26 (24.8%)
>50	20 (19.0%)
Parous	79 (75.2%)
Nulligravida, unmarried or adolescent	26 (24.8%)
Right-sided lesion	40 (38.1%)
Left-sided lesion	27 (25.7%)
Bilateral lesions	7 (6.7%)
Laterality not specified	31 (29.5%)

DISCUSSION

Accurate preoperative characterization of ovarian neoplasms is important for appropriate surgical planning, referral to gynaecologic oncology services, and preservation of fertility where feasible. Ultrasonography remains the first-line imaging modality for the assessment of adnexal masses; however, MRI has an important problem-solving role when lesions remain indeterminate following sonographic evaluation. MRI provides superior soft-tissue characterization and allows assessment of tissue components such as fat, haemorrhage, fibrous tissue, solid components, and enhancement characteristics.[5,7]

In the present study, MRI demonstrated high diagnostic performance in differentiating benign from borderline/malignant ovarian neoplasms, with a sensitivity of 84.4% and specificity of 100%, positive predictive value of 100%, negative predictive value of 93.6%, and overall diagnostic accuracy of 95.2%. Agreement between MRI classification and histopathological diagnosis was excellent (κ=0.88). These findings indicate particularly high specificity for malignancy in the present study, with no histopathologically benign lesion being incorrectly classified as malignant. These findings are comparable with previous MRI studies using surgical histopathology as the reference standard, although reported diagnostic performance has varied according to patient selection, MRI protocol and classification criteria.[12,13,15,16]

The findings are broadly consistent with previous studies evaluating MRI for the characterization of adnexal masses. Sohaib et al. demonstrated high accuracy of MRI in characterizing complex adnexal masses and identified morphological features such as vegetations and ascites as important predictors of malignancy.[7] More recently, Thomassin-Naggara et al in a large multicentre validation study of the O-RADS MRI score, reported a sensitivity of 93%and specificity of 91% for the diagnosis of malignancy in sonographically indeterminate adnexal masses.[8] A subsequent systematic review and meta-analysis of O-RADS MRI demonstrated pooled sensitivity and specificity of approximately 92% and 91%, respectively.[10] Compared with these studies, the present study demonstrated somewhat lower sensitivity but higher specificity. Differences in patient selection, prevalence and spectrum of malignant lesions, sample size, MRI protocols, and interpretation criteria may account for these variations in diagnostic performance. The high specificity observed in the present study is clinically relevant. None of the 73 histopathologically benign lesions was incorrectly classified as malignant on MRI.

Avoiding false-positive diagnoses may reduce unnecessary extensive surgery or oncological referral in women with benign ovarian lesions, particularly younger women in whom ovarian preservation is desirable. However, five of the 32 borderline/malignant lesions were classified as benign on MRI. These false-negative cases account for the comparatively lower sensitivity of 84.4% and emphasize that MRI, despite its high diagnostic performance, cannot replace definitive histopathological examination. The ability of MRI to characterize adnexal lesions is related to the information obtained from conventional and functional sequences. T1- and T2-weighted sequences facilitate characterization of fat, haemorrhage and fibrous components, while DWI and contrast-enhanced sequences provide additional information regarding solid tissue and tumour vascularity. The ESUR recommends DWI and contrast-enhanced MRI, preferably dynamic contrast-enhanced imaging when available, for the evaluation of complex cystic or cystic-solid indeterminate adnexal masses.[5] Standardized risk-stratification systems may further improve the reproducibility and clinical utility of MRI. The O-RADS MRI system provides a structured approach to assigning

the risk of malignancy in sonographically indeterminate adnexal masses.[8] A systematic review and meta-analysis involving more than 4,500 adnexal lesions demonstrated high overall diagnostic performance of O-RADS MRI, supporting its use for standardized MRI assessment.[10] More recent ESUR practice recommendations also identify MRI as the modality of choice for further characterization of ultrasonographically indeterminate ovarian masses and support standardized O-RADS MRI terminology for communication with clinicians.[11]

From a gynaecological perspective, accurate preoperative risk assessment has direct implications for patient management. Confident characterization of a lesion as benign may support conservative or fertility-sparing surgical approaches where clinically appropriate, whereas identification of features suspicious for malignancy facilitates appropriate counselling, operative planning, and referral to a gynaecologic oncologist. MRI should therefore be considered a complementary problem-solving investigation in appropriately selected patients rather than a replacement for ultrasonography or histopathological examination.[5,11] The principal strength of the present study is the use of histopathological examination as the reference standard in all included patients, allowing direct assessment of MRI diagnostic performance. The study also reflects routine clinical practice in a tertiary care setting and provides clinically relevant information regarding the ability of MRI to differentiate benign from borderline/malignant ovarian neoplasms. Diffusion-weighted MRI may improve characterization of epithelial ovarian tumours, although overlap between borderline and malignant lesions remains a recognized diagnostic challenge.[14]

Several limitations should be acknowledged. This was a retrospective, single-centre study with a relatively modest sample size, which may limit the generalizability of the findings. Selection bias is possible because only surgically managed patients with available MRI and histopathological examination were included. Interobserver variability in MRI interpretation was not assessed. Furthermore, MRI findings were not prospectively categorized using a standardized risk-stratification system such as O-RADS MRI. The relatively small number of borderline or malignant lesions may also have influenced the estimates of sensitivity and specificity. Larger prospective multicentre studies using standardized MRI acquisition and reporting systems are required to validate these findings.

CONCLUSION

Magnetic resonance imaging demonstrated high diagnostic accuracy and excellent agreement with histopathological examination in differentiating benign from borderline/malignant ovarian neoplasms. Its high specificity supports its role as a valuable problem-solving modality in the preoperative characterization of indeterminate adnexal masses and may assist in appropriate surgical planning and referral. However, the occurrence of false-negative MRI findings emphasizes that histopathological examination remains the definitive standard for diagnosis. MRI should therefore be used as a complementary tool in the preoperative assessment of ovarian neoplasms rather than as a substitute for histopathological confirmation.

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