



Original Research Article

ULTRASONOGRAPHY AND MRI IN THE DIFFERENTIATION OF BENIGN AND MALIGNANT ADNEXAL LESIONS: A COMPARATIVE STUDY

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Received : 30/07/2026
Received in revised form : 06/09/2026
Accepted : 17/09/2026

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DOI: 10.70034/ijmedph.2026.3.917

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 5959-5966

ABSTRACT

Background: Accurate preoperative characterization of female adnexal lesions is essential for differentiating benign masses from borderline and malignant tumours, determining appropriate referral and avoiding unnecessary surgery. This study compared ultrasonography and magnetic resonance imaging for the detection, characterization and risk stratification of adnexal lesions using histopathology as the reference standard.

Materials and Methods: This prospective comparative diagnostic-accuracy study included 63 women with clinically or radiologically suspected adnexal lesions undergoing surgical excision. Each participant underwent transabdominal and/or transvaginal ultrasonography with Doppler assessment, followed by pelvic MRI incorporating T1-weighted, T2-weighted, fat-suppressed, diffusion-weighted and contrast-enhanced sequences. Lesions were categorized using O-RADS US and O-RADS MRI. Histopathological findings were used as the reference standard, with borderline tumours grouped with malignant lesions for diagnostic-accuracy calculations.

Results: The mean participant age was 42.8±13.6 years. Histopathology demonstrated 45 (71.4%) benign lesions, five (7.9%) borderline tumours and 13 (20.6%) malignancies. MRI was more accurate than ultrasonography in determining lesion origin (96.8% versus 85.7%; $p=0.016$), characterizing internal composition (93.7% versus 82.5%; $p=0.016$) and providing an exact diagnosis concordant with histopathology (90.5% versus 73.0%; $p=0.003$). Indeterminate findings decreased from 15.9% with ultrasonography to 4.8% with MRI ($p=0.039$). Ultrasonography demonstrated 77.8% sensitivity, 80.0% specificity and 79.4% accuracy, compared with 94.4%, 95.6% and 95.2%, respectively, for MRI. MRI showed significantly higher overall accuracy ($p=0.006$) and a greater area under the ROC curve (0.981 versus 0.857; $p<0.001$).

Conclusion: Ultrasonography remains an appropriate first-line modality for adnexal lesion evaluation. MRI provides superior tissue characterization, specificity and overall diagnostic accuracy and is particularly useful for complex or sonographically indeterminate lesions. Their complementary use can improve malignancy risk stratification and facilitate appropriate surgical and oncological planning.

Keywords: Adnexal mass; magnetic resonance imaging; O-RADS MRI; O-RADS US; ovarian tumour.

INTRODUCTION

Female adnexal lesions encompass a heterogeneous group of ovarian, tubal, paraovarian and non-gynaecological abnormalities, ranging from physiological cysts and benign neoplasms to borderline tumours and invasive malignancies. Although most adnexal masses are benign, accurate preoperative characterization is essential because delayed recognition of malignancy may adversely affect prognosis, whereas overdiagnosis can lead to unnecessary surgery, loss of fertility and increased healthcare expenditure.^[1]

Ultrasonography (USG), incorporating transabdominal and transvaginal imaging with colour and spectral Doppler, is the recommended first-line investigation because it is widely available, inexpensive, radiation-free and capable of providing real-time assessment of lesion morphology and vascularity.^[1,2] Features such as lesion size, wall irregularity, septations, papillary projections, solid components, acoustic shadows, vascularity, ascites and peritoneal nodules assist in differentiating benign from malignant masses. Standardized approaches, including the International Ovarian Tumor Analysis (IOTA) Simple Rules, ADNEX model and Ovarian-Adnexal Reporting and Data System for ultrasonography (O-RADS US), have improved diagnostic consistency and risk stratification.^[2-4] A meta-analysis of 19,674 adnexal tumours reported that expert subjective ultrasound assessment achieved 93% sensitivity and 89% specificity, while IOTA Simple Rules demonstrated 93% sensitivity and 80% specificity.^[4]

Nevertheless, approximately one-quarter of adnexal masses detected on ultrasonography remain indeterminate because of complex morphology, large lesion size, limited acoustic windows or uncertain organ of origin.^[5] Magnetic resonance imaging (MRI) is particularly valuable in these circumstances because of its superior soft-tissue contrast, multiplanar capability and ability to characterize blood, fat, fibrous tissue and enhancing solid components.^[5,6] Diffusion-weighted imaging and dynamic contrast-enhanced sequences further improve tissue characterization and malignancy assessment. The validated O-RADS MRI system demonstrated an area under the receiver-operating-characteristic curve of 0.961, with 93% sensitivity and 91% specificity for malignancy.^[6] A comparative meta-analysis found pooled sensitivity and specificity of 96% and 79% for IOTA-ADNEX versus 91% and 95% for MRI-based ADNEX assessment, respectively.^[7]

Thus, USG and MRI provide complementary diagnostic information. Direct comparison with histopathology is required to determine their relative accuracy in lesion detection, characterization, localization and differentiation of benign from malignant adnexal pathology.^[8,9]

MATERIALS AND METHODS

Study design and setting

This prospective comparative diagnostic-accuracy study was conducted in the Departments of Radiodiagnosis, Obstetrics and Gynaecology, and Pathology of a tertiary-care teaching hospital in India over a period of 18 months. Women with a clinically suspected or previously detected adnexal lesion who were referred for imaging and subsequently scheduled for surgery were enrolled consecutively. The study compared ultrasonography (USG) and magnetic resonance imaging (MRI) for lesion detection, determination of organ of origin, morphological characterization, and differentiation between benign and malignant adnexal lesions. Histopathological examination of the surgical specimen was considered the reference standard.

Study participants

Women aged ≥ 18 years presenting with pelvic pain, abdominal distension, menstrual disturbances, infertility, postmenopausal bleeding, a palpable pelvic mass, or an incidentally detected adnexal abnormality were assessed for eligibility. Patients were included when an adnexal lesion was suspected clinically or identified on preliminary imaging, both USG and MRI could be completed before treatment, and subsequent surgical excision with histopathological evaluation was planned. Patients with pregnancy, previously diagnosed or treated ovarian malignancy, prior pelvic surgery within three months, contraindications to MRI, severe claustrophobia, non-MRI-compatible metallic implants, estimated glomerular filtration rate below 30 mL/min/1.73 m², or a history of severe gadolinium hypersensitivity were excluded. Patients with incomplete imaging, technically inadequate examinations, or unavailable histopathology were also excluded.

Clinical assessment

Demographic and clinical information, including age, menopausal status, presenting symptoms, symptom duration, parity, menstrual history, family history of ovarian or breast malignancy, previous pelvic surgery and serum CA-125 level, when available, was recorded using a structured proforma. Menopausal status was defined as amenorrhoea for at least 12 consecutive months in the absence of another physiological or pathological cause. USG and MRI were performed within seven days of each other and before surgery, with no therapeutic intervention between the two examinations.

Ultrasonographic evaluation

Ultrasonography was performed using a high-resolution ultrasound system equipped with a 3–5 MHz curvilinear transabdominal transducer and a 5–9 MHz endovaginal transducer. Transabdominal examination was conducted with a comfortably full urinary bladder, followed by transvaginal examination after bladder emptying whenever clinically appropriate. Unmarried women, patients

declining transvaginal examination, and those in whom it was unsuitable underwent transabdominal evaluation alone.

Each lesion was assessed for laterality, maximum diameter, ovarian or extraovarian origin, unilocular or multilocular configuration, wall thickness and regularity, septations, internal echoes, papillary projections, solid components, acoustic shadowing and posterior enhancement. Colour and spectral Doppler were used to evaluate vascularity within the wall, septa, papillary projections and solid portions. Associated findings, including ascites, peritoneal deposits, lymphadenopathy, omental thickening and contralateral ovarian abnormalities, were recorded. Lesions were categorized according to the Ovarian-Adnexal Reporting and Data System for ultrasonography (O-RADS US) and were provisionally classified as benign, indeterminate or malignant.

Magnetic resonance imaging

Pelvic MRI was performed on a 1.5-T scanner using a phased-array pelvic coil. The protocol included axial T1-weighted images; axial, sagittal and coronal T2-weighted images; fat-suppressed T1-weighted images; diffusion-weighted imaging using b values of 0 and 800–1000 s/mm²; and apparent diffusion coefficient maps. Dynamic fat-suppressed contrast-enhanced T1-weighted imaging was performed after intravenous administration of gadolinium-based contrast at 0.1 mmol/kg in eligible patients.

MRI assessment included lesion origin, size, morphology, signal characteristics, fat, blood products, fibrous tissue, septations, mural nodules, papillary projections, enhancing solid components, diffusion restriction and enhancement pattern. Local invasion, ascites, lymphadenopathy, peritoneal deposits and distant pelvic disease were documented. Each lesion was assigned an O-RADS MRI category and classified as benign, indeterminate or malignant.

Image interpretation and reference standard

USG and MRI examinations were interpreted independently by two radiologists experienced in female pelvic imaging. The MRI reader was blinded to the detailed USG categorization, and both readers were blinded to histopathological findings. Disagreements were resolved by consensus. Surgical specimens were evaluated by an experienced pathologist according to standard histopathological criteria and classified as benign,

borderline or malignant. For diagnostic calculations, borderline tumours were grouped with malignant lesions because they generally require oncological surgical planning.

Outcome measures and statistical analysis

The primary outcomes were the sensitivity, specificity, positive predictive value, negative predictive value and overall diagnostic accuracy of USG and MRI for detecting malignant adnexal lesions. Secondary outcomes included correct identification of lesion origin, agreement with histopathological diagnosis, characterization of specific tissue components and diagnostic performance in indeterminate lesions. Categorical variables were presented as frequencies and percentages, whereas continuous variables were summarized as mean±standard deviation or median with interquartile range. McNemar's test compared paired sensitivity and specificity, and receiver-operating-characteristic curves were used to compare areas under the curve. Agreement was assessed using Cohen's kappa coefficient. A two-sided p value <0.05 was considered statistically significant.

Ethical considerations

The study protocol was approved by the Institutional Ethics Committee before recruitment. Written informed consent was obtained from every participant. Confidentiality was maintained through coded study identifiers, and all procedures were conducted in accordance with the Declaration of Helsinki.

RESULTS

The mean age of the participants was 42.8±13.6 years, with 42 (66.7%) being premenopausal and 21 (33.3%) postmenopausal. Lower abdominal or pelvic pain was the most frequent presentation, reported by 34 (54.0%) participants, followed by abdominal distension or heaviness in 19 (30.2%) and menstrual irregularity or abnormal uterine bleeding in 14 (22.2%). The median serum CA-125 level was 31 U/mL (IQR: 17–88), while 24 (38.1%) participants had levels >35 U/mL. The mean maximum lesion diameter was 8.4±4.1 cm. Right-sided, left-sided and bilateral lesions were identified in 47.6%, 44.4% and 7.9% of participants, respectively. [Table 1]

Table 1: Baseline demographic and clinical characteristics of the study participants (N=63)

Characteristic	Frequency (%) / mean ± SD / median (IQR)
Age, years	42.8 ± 13.6
Age group	
18–29 years	12 (19.0)
30–39 years	15 (23.8)
40–49 years	14 (22.2)
50–59 years	13 (20.6)
≥60 years	9 (14.3)
Menopausal status	
Premenopausal	42 (66.7)

Postmenopausal	21 (33.3)
Body mass index, kg/m²	24.7 ± 3.8
Rural residence	39 (61.9)
Urban residence	24 (38.1)
Parity	
Nulliparous	9 (14.3)
1–2	33 (52.4)
≥3	21 (33.3)
*Clinical presentation	
Lower abdominal/pelvic pain	34 (54.0)
Abdominal distension or heaviness	19 (30.2)
Menstrual irregularity/abnormal uterine bleeding	14 (22.2)
Palpable abdominopelvic mass	11 (17.5)
Infertility	6 (9.5)
Postmenopausal bleeding	5 (7.9)
Incidentally detected lesion	8 (12.7)
Serum CA-125, U/mL	31 (17–88)
Serum CA-125 >35 U/mL	24 (38.1)
Maximum lesion diameter, cm	8.4 ± 4.1
Laterality of the index lesion	
Right-sided	30 (47.6)
Left-sided	28 (44.4)
Bilateral	5 (7.9)

*Participants could have more than one presenting symptom; therefore, percentages do not total 100%; CA-125, cancer antigen 125; IQR, interquartile range; SD, standard deviation.

Histopathological examination identified 45 (71.4%) benign lesions, five (7.9%) borderline tumours and 13 (20.6%) malignant lesions. Serous cystadenoma was the most frequent benign diagnosis, observed in 11 (17.5%) participants, followed by functional or

haemorrhagic cysts in eight (12.7%), and mucinous cystadenoma and mature cystic teratoma in seven (11.1%) each. Borderline lesions comprised three serous and two mucinous borderline tumours. High-grade serous carcinoma was the most common malignancy, accounting for six (9.5%) lesions, followed by mucinous and endometrioid carcinomas in two (3.2%) participants each. [Table 2]

Table 2: Histopathological spectrum of adnexal lesions among the study participants (N=63)

Histopathological diagnosis	Frequency (%)
Benign lesions	45 (71.4)
Serous cystadenoma	11 (17.5)
Functional/haemorrhagic cyst	8 (12.7)
Mucinous cystadenoma	7 (11.1)
Mature cystic teratoma	7 (11.1)
Endometrioma	6 (9.5)
Fibroma/thecoma	3 (4.8)
Hydrosalpinx/paratubal cyst	3 (4.8)
Borderline tumours	5 (7.9)
Serous borderline tumour	3 (4.8)
Mucinous borderline tumour	2 (3.2)
Malignant lesions	13 (20.6)
High-grade serous carcinoma	6 (9.5)
Mucinous carcinoma	2 (3.2)
Endometrioid carcinoma	2 (3.2)
Clear-cell carcinoma	1 (1.6)
Adult granulosa-cell tumour	1 (1.6)
Metastatic ovarian tumour	1 (1.6)

Participants with borderline or malignant lesions were significantly older than those with benign lesions (51.3±12.4 versus 39.4±12.0 years; p=0.002) and were more frequently postmenopausal (61.1% versus 22.2%; p=0.007). Elevated CA-125 levels were present in 77.8% of borderline/malignant

lesions compared with 22.2% of benign lesions (p<0.001). Borderline/malignant lesions were also larger (10.9±4.8 versus 7.4±3.3 cm; p=0.009) and more frequently demonstrated ascites, solid components, papillary projections and moderate-to-marked Doppler vascularity (all p<0.001). [Table 3]

Table 3: Association of clinical and imaging characteristics with histopathological classification (N=63)

Characteristic	Benign lesions (n=45)	Borderline/ malignant lesions (n=18)	p value
	Frequency (%) / mean ± SD		
Age, years	39.4 ± 12.0	51.3 ± 12.4	0.002
Postmenopausal status	10 (22.2)	11 (61.1)	0.007
CA-125 >35 U/mL	10 (22.2)	14 (77.8)	<0.001

Maximum lesion diameter, cm	7.4 ± 3.3	10.9 ± 4.8	0.009
Ascites	3 (6.7)	9 (50.0)	<0.001
Solid component	8 (17.8)	15 (83.3)	<0.001
Papillary projection	4 (8.9)	12 (66.7)	<0.001
Moderate/marked Doppler vascularity	9 (20.0)	14 (77.8)	<0.001

CA-125, cancer antigen 125

Both ultrasonography and MRI detected all 63 index lesions. MRI was significantly more accurate than ultrasonography in determining adnexal or extra-adnexal origin (96.8% versus 85.7%; $p=0.016$), characterizing internal lesion composition (93.7% versus 82.5%; $p=0.016$), and achieving an exact preoperative diagnosis concordant with

histopathology (90.5% versus 73.0%; $p=0.003$). MRI also reduced the proportion of indeterminate lesions from 15.9% with ultrasonography to 4.8% ($p=0.039$). Although MRI showed higher accuracy in identifying fat or blood products and evaluating local extension, these differences did not reach statistical significance. [Table 4]

Table 4: Paired comparison of ultrasonography and MRI for the detection and characterization of adnexal lesions

Diagnostic parameter	Eligible lesions	USG	MRI	p value
	Frequency	Frequency (%)	Frequency (%)	
Detection of the index lesion	63	63 (100.0)	63 (100.0)	—
Correct determination of adnexal or extra-adnexal origin	63	54 (85.7)	61 (96.8)	0.016
Correct identification of laterality	63	59 (93.7)	62 (98.4)	0.25
Correct characterization of internal composition	63	52 (82.5)	59 (93.7)	0.016
Correct identification of fat or blood products†	13	10 (76.9)	13 (100.0)	0.25
Correct assessment of local extension‡	13	7 (53.8)	11 (84.6)	0.125
Exact preoperative characterization concordant with histopathology	63	46 (73.0)	57 (90.5)	0.003
Lesions remaining indeterminate after examination	63	10 (15.9)	3 (4.8)	0.039

†Included seven mature cystic teratomas and six endometriomas;

‡Evaluated among 13 histologically confirmed invasive malignant lesions; MRI, magnetic resonance imaging; USG, ultrasonography
O-RADS categories were significantly associated with histopathological classification for both ultrasonography and MRI (both $p<0.001$). On ultrasonography, 36 of 45 benign lesions (80.0%)

were classified as O-RADS US 2 or 3, whereas 14 of 18 borderline/malignant lesions (77.8%) were categorized as O-RADS US 4 or 5. On MRI, 43 of 45 benign lesions (95.6%) were assigned O-RADS MRI categories 2 or 3, while 17 of 18 borderline/malignant lesions (94.4%) were classified as O-RADS MRI 4 or 5. No borderline or malignant lesion was classified as O-RADS MRI 2. [Table 5]

Table 5: Distribution of O-RADS US and O-RADS MRI categories according to histopathological classification

Imaging system and category	Benign lesions (n=45)	Borderline/ malignant lesions (n=18)	Total (N=63)	p value
	Frequency (%)	Frequency (%)	Frequency (%)	
O-RADS US				
O-RADS US 2	21 (46.7)	0 (0.0)	21 (33.3)	<0.001
O-RADS US 3	15 (33.3)	4 (22.2)	19 (30.2)	
O-RADS US 4	7 (15.6)	8 (44.4)	15 (23.8)	
O-RADS US 5	2 (4.4)	6 (33.3)	8 (12.7)	
O-RADS MRI				
O-RADS MRI 2	30 (66.7)	0 (0.0)	30 (47.6)	<0.001
O-RADS MRI 3	13 (28.9)	1 (5.6)	14 (22.2)	
O-RADS MRI 4	2 (4.4)	7 (38.9)	9 (14.3)	
O-RADS MRI 5	0 (0.0)	10 (55.6)	10 (15.9)	

MRI, magnetic resonance imaging; O-RADS, Ovarian-Adnexal Reporting and Data System; US, ultrasonography.

Using histopathology as the reference standard, ultrasonography demonstrated a sensitivity of 77.8%, specificity of 80.0%, positive predictive value of 60.9%, negative predictive value of 90.0% and overall accuracy of 79.4%. MRI achieved corresponding values of 94.4%, 95.6%, 89.5%,

97.7% and 95.2%, respectively. MRI had significantly higher specificity ($p=0.039$) and overall accuracy ($p=0.006$), although the difference in sensitivity was not statistically significant ($p=0.250$). The area under the ROC curve was also significantly greater for MRI than for ultrasonography (0.981 versus 0.857; $p<0.001$). [Table 6]

Table 6: Diagnostic performance of ultrasonography and MRI for differentiating benign from borderline or malignant adnexal lesions

Diagnostic measure	USG	MRI	p value
True positive, n	14	17	—
False negative, n	4	1	—
True negative, n	36	43	—
False positive, n	9	2	—
Sensitivity, % (95% CI)	77.8 (54.8–91.0)	94.4 (74.2–99.0)	0.25
Specificity, % (95% CI)	80.0 (66.2–89.1)	95.6 (85.2–98.8)	0.039
Positive predictive value, % (95% CI)	60.9 (40.8–77.8)	89.5 (68.6–97.1)	—
Negative predictive value, % (95% CI)	90.0 (76.9–96.0)	97.7 (88.2–99.6)	—
Overall accuracy, % (95% CI)	79.4 (67.8–87.5)	95.2 (86.9–98.4)	0.006
Positive likelihood ratio	3.89	21.25	—
Negative likelihood ratio	0.28	0.06	—
Area under the ROC curve (95% CI)	0.857 (0.770–0.944)	0.981 (0.956–1.000)	<0.001

CI, confidence interval; MRI, magnetic resonance imaging; ROC, receiver-operating-characteristic; USG, ultrasonography.

DISCUSSION

The present study demonstrated that ultrasonography and MRI were both capable of detecting adnexal lesions, but MRI provided superior lesion characterization and malignancy risk stratification. Histopathologically, 71.4% of lesions were benign, 7.9% borderline and 20.6% malignant. Serous cystadenoma was the commonest benign lesion, while high-grade serous carcinoma predominated among malignancies. This pattern is consistent with an Indian study of 212 ovarian tumours by Gupta et al., in which serous cystadenoma and serous carcinoma were the most frequent benign and malignant tumours, respectively.^[10] The predominance of benign lesions reflects the frequent occurrence of functional cysts and benign epithelial neoplasms among reproductive-age women.

Borderline or malignant lesions occurred at a significantly higher age than benign lesions (51.3 versus 39.4 years; $p=0.002$) and were more frequently associated with postmenopausal status (61.1% versus 22.2%; $p=0.007$), CA-125 elevation (77.8% versus 22.2%; $p<0.001$), larger size (10.9 versus 7.4 cm; $p=0.009$), ascites, solid tissue, papillary projections and increased Doppler vascularity. These features are biologically plausible because malignant tumours exhibit angiogenesis, stromal invasion, cellular proliferation and peritoneal irritation, producing neovascularity, enhancing solid tissue and ascites. Hricak et al., similarly found that necrosis within solid tissue and vegetations within cystic lesions were strong MRI predictors of malignancy, with odds ratios of 107 and 40, respectively.^[14]

Although both modalities detected all index lesions, MRI was significantly better for determining lesion origin (96.8% versus 85.7%; $p=0.016$), characterizing internal composition (93.7% versus 82.5%; $p=0.016$) and establishing an exact diagnosis concordant with histopathology (90.5% versus 73.0%; $p=0.003$). MRI also reduced indeterminate examinations from 15.9% to 4.8% ($p=0.039$). Sohaib et al., likewise reported greater accuracy for

MRI than ultrasound (88.9% versus 63.9%),^[11] while Adusumilli et al., found 100% sensitivity and 94% specificity for MRI in sonographically indeterminate masses.^[12] Chilla et al., observed that MRI provided major additional diagnostic information in 28.9% of indeterminate cases and prevented surgery in five patients.^[13] Yamashita et al., particularly noted improved MRI characterization of mature teratomas and endometriomas.^[15] These advantages arise from multiplanar imaging and the ability of T1-, T2- and fat-suppressed sequences to distinguish fat, blood, simple fluid and fibrous tissue.

Using O-RADS ≥ 4 as the malignant threshold, ultrasonography achieved 77.8% sensitivity, 80.0% specificity and 79.4% accuracy. Cao et al., reported higher O-RADS US sensitivity of 98.7% but comparable specificity of 83.2% in 1,054 masses.^[16] A meta-analysis by Vara et al., reported pooled sensitivity and specificity of 97% and 77%, respectively.^[17] The comparatively lower sensitivity in the present study may reflect the small number of malignant lesions, inclusion of borderline tumours as malignant, operator dependence and overlap between complex benign and early malignant morphology. Borderline tumours are particularly challenging because papillary projections may be present without destructive stromal invasion.

MRI achieved 94.4% sensitivity, 95.6% specificity and 95.2% accuracy, significantly outperforming ultrasonography in specificity ($p=0.039$) and overall accuracy ($p=0.006$). Its AUC was also greater (0.981 versus 0.857; $p<0.001$). Zhang et al., reported pooled O-RADS MRI sensitivity and specificity of 95% and 90%, compared with 95% and 82% for O-RADS US.^[18] Similarly, Rizzo et al., obtained summary sensitivity and specificity of 92% and 91% for O-RADS MRI,^[20] while Wu et al., reported reader-specific sensitivities of 83.3–90.5% and specificities of 93.1–95.3%.^[21] The high specificity in the current study may be attributed to standardized MRI descriptors,^[19] diffusion-weighted imaging and contrast-enhancement patterns. Quantitative diffusion assessment may further improve discrimination of cellular malignant tissue from benign solid components.^[22]

MRI should nevertheless be considered complementary rather than a replacement for ultrasonography. Expert ultrasound can achieve excellent performance; Chacon et al., reported 96% sensitivity and 93% specificity for expert ultrasound compared with 100% and 81% for MRI in IOTA-indeterminate masses.^[23] Thus, ultrasound remains the practical first-line modality, particularly in resource-constrained Indian settings, whereas MRI is most valuable for complex, large, indeterminate or suspicious lesions requiring confident characterization and preoperative planning.

Limitations

This study had several limitations. The single-centre design and relatively small sample, particularly the limited number of borderline and malignant lesions, restrict generalizability and produced wide confidence intervals. Only surgically excised lesions with available histopathology were analysed, creating possible selection and verification bias. Ultrasonography remains operator-dependent, while interobserver agreement was not formally evaluated. Additionally, cost-effectiveness, patient acceptability and long-term outcomes of imaging-guided management were not assessed.

CONCLUSION

In this comparative study, both ultrasonography and MRI detected adnexal lesions effectively; however, MRI provided superior determination of lesion origin, tissue characterization and differentiation of benign from borderline or malignant pathology. MRI achieved significantly greater specificity, overall accuracy and ROC performance and substantially reduced the proportion of indeterminate lesions. Ultrasonography should remain the first-line examination because it is accessible, inexpensive and suitable for real-time morphological and vascular assessment. MRI should be used as a complementary problem-solving modality for large, complex, indeterminate or suspicious lesions, where confident characterization can guide referral, surgical planning and fertility-preserving management while reducing unnecessary intervention for benign disease.

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