



CLINICORADIOLOGICAL CORRELATION OF ADNEXAL MASSES USING ULTRASOUND AND MRI IN A TERTIARY CARE HOSPITAL: A RETROSPECTIVE STUDY

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ABSTRACT

Background: Adnexal masses represent a diagnostically challenging and clinically significant group of gynaecological conditions encountered across all reproductive age groups. In Bihar, the combination of delayed healthcare presentation, limited access to specialist gynaecological oncology services, and a high prevalence of pelvic inflammatory disease, endometriosis, and tubo-ovarian abscess creates a distinctive regional adnexal mass spectrum that differs from published urban tertiary care series. Accurate pre-operative characterisation of adnexal masses as benign, borderline, or malignant has major implications for surgical planning — determining whether laparoscopic versus open surgery, conservative versus radical resection, and specialist oncological input are required. Ultrasound (USG) remains the first-line imaging modality, while MRI provides superior soft-tissue contrast, multiplanar capability, and functional sequences (diffusion-weighted imaging, dynamic contrast enhancement) that significantly improve characterisation of sonographically indeterminate masses. Despite MRI's established superiority for complex mass assessment, its systematic comparative evaluation against USG with histopathological correlation in a North Bihar tertiary care setting has not been formally conducted at RDJMMCH, Muzaffarpur.

Objectives: To evaluate the clinicoradiological correlation of adnexal masses using ultrasound and MRI at RDJMMCH, Muzaffarpur, July 2024–February 2025; to determine and compare the diagnostic performance (sensitivity, specificity, PPV, NPV, accuracy, AUC) of USG and MRI against histopathological gold standard; and to identify independent imaging and clinical predictors of malignancy.

Methodology: Retrospective observational study of 186 consecutive adult female patients with confirmed adnexal masses who underwent both USG (transabdominal + transvaginal) and MRI pelvis (1.5T, multiparametric protocol: T1, T2, DWI, DCE) at RDJMMCH, Muzaffarpur, during July 2024–February 2025, with subsequent histopathological confirmation. Masses classified per O-RADS (ACR 2020) for USG and O-RADS MRI (Thomassin-Naggara 2020) for MRI. Statistical

analysis: IBM SPSS v26 — chi-square, ANOVA, multivariate logistic regression, ROC analysis, Cohen's weighted kappa.

Results: 186 patients; mean age 42.2 ± 13.8 years. Histopathology: benign 74.2% (n=138), borderline 8.6% (n=16), malignant 17.2% (n=32). Most common diagnoses: serous cystadenoma 23.7%, dermoid/teratoma 19.4%, endometrioma 15.1%. USG: sensitivity 87.5%, specificity 83.3%, accuracy 84.9%, AUC 0.88. MRI: sensitivity 96.9%, specificity 92.8%, accuracy 93.5%, AUC 0.93. Combined USG+MRI: sensitivity 96.9%, specificity 95.7%, accuracy 95.7%, AUC 0.96. MRI significantly outperformed USG for peritoneal seedling detection (82.4% vs 28.5%), solid component characterisation (91.4% vs 72.0%), and ascites characterisation. Independent MRI predictors of malignancy: solid component (OR 12.36), peritoneal seedlings (OR 18.62), DWI restriction $ADC < 1.0 \times 10^{-3} \text{ mm}^2/\text{s}$ (OR 11.48). USG–MRI O-RADS concordance: 79.0%; weighted $\kappa = 0.78$ ($p < 0.001$).

Conclusion: MRI demonstrates substantially superior diagnostic performance over USG alone for characterising adnexal masses at RDJMMCH, Muzaffarpur, and should be systematically used as the second-line modality for all USG-indeterminate masses, particularly for pre-operative malignancy risk stratification and surgical pathway determination. O-RADS system implementation in routine radiology reporting is recommended to standardise risk communication between radiologists and gynaecologists at RDJMMCH.

Keywords: Adnexal masses; ultrasound; MRI; O-RADS; ovarian malignancy; clinicoradiological; Bihar; Muzaffarpur; RDJMMCH; DWI

1. INTRODUCTION

Adnexal masses — comprising ovarian, paraovarian, fallopian tube, and broad ligament lesions — are among the most diagnostically challenging entities in gynaecological practice, encountered in approximately 5–10% of women undergoing pelvic imaging in tertiary care settings.¹ The clinical significance of these masses spans a wide spectrum from asymptomatic functional cysts and benign neoplasms to borderline tumours and frankly malignant ovarian carcinomas that carry a five-year survival rate below 30% when diagnosed at advanced stage.^{1,2} Ovarian cancer ranks as the seventh most common cancer in women globally and the fourth leading cause of cancer-related female mortality in India, with population-based cancer registry data confirming a steady increase in age-standardised incidence rates across Indian states including Bihar.²

The primary objective of adnexal mass imaging is accurate pre-operative categorisation as benign, borderline, or malignant — a determination that fundamentally alters surgical approach, degree of resection, need for oncological input, and patient counselling.⁴ Transvaginal and transabdominal ultrasound (USG) remain the universally recommended first-line imaging modality due to their wide availability, low cost, dynamic capability, and well-validated diagnostic frameworks including the International Ovarian Tumor Analysis (IOTA) simple rules, ADNEX model, and the Ovarian-Adnexal Reporting and Data System (O-RADS).^{3,4,15} Ultrasound sensitivity for malignancy detection in published meta-analyses ranges from 82–97%, with specificity of 72–92%.^{7,8}

Magnetic resonance imaging (MRI) of the pelvis, deployed as a second-line modality for sonographically indeterminate or complex masses, offers multiple advantages over USG — superior soft-tissue contrast resolution, multiplanar capability, tissue characterisation sequences (fat suppression, T2 signal mapping), and functional sequences including diffusion-weighted imaging (DWI) with apparent diffusion coefficient (ADC) quantification and dynamic contrast enhancement (DCE).^{5,14} The O-RADS MRI scoring system (Thomassin-Naggara et al., JAMA Netw Open, 2020) provides a standardised 5-point risk stratification framework for sonographically indeterminate adnexal masses on MRI, achieving pooled sensitivity of 95% and specificity of 90% across published validation studies.^{5,6,7}

Radha Devi Jageshwari Memorial Medical College & Hospital (RDJMMCH), Muzaffarpur, Bihar, serves as the apex gynaecological and oncological referral centre for the Tirhut and Mithila

divisions, regularly receiving referrals from Muzaffarpur, Sitamarhi, Sheohar, East Champaran, Vaishali, Samastipur, and Darbhanga districts. The regional adnexal mass spectrum at RDJMMCH carries a distinctive character: a relatively high burden of tubo-ovarian abscess from pelvic inflammatory disease prevalent in young rural patients with limited access to early antibiotic therapy; a significant endometriosis burden in the reproductive age group compounded by diagnostic delays; and ovarian malignancy presenting predominantly at advanced FIGO Stage III/IV due to delayed specialist referral — a pattern consistent with published Eastern India oncology data. No prior RDJMMCH study had systematically compared USG and MRI performance for adnexal mass characterisation with histopathological correlation, creating an institutional evidence gap that this retrospective study addresses.

2. REVIEW OF LITERATURE

Rizzo et al.⁶ (Radiology, 2023; PMID 36594815) published a landmark systematic review and meta-analysis of O-RADS MRI performance across 15 studies, reporting pooled sensitivity 95% and specificity 90% for malignancy characterisation — establishing O-RADS MRI as the international standard against which institutional MRI performance is compared in the RDJMMCH study. The study confirmed O-RADS MRI's category-by-category malignancy rates: O-RADS 2 (<1%), O-RADS 3 (5–14%), O-RADS 4 (50%), O-RADS 5 (>90%).

Zhang et al.⁷ (AJR, 2023; PMID 36722758) conducted a comprehensive meta-analysis of 26 studies (9,520 patients) evaluating both O-RADS US and O-RADS MRI, documenting pooled sensitivity and specificity of O-RADS US of 95% and 82%, and of O-RADS MRI of 95% and 90% — the critical specificity improvement of MRI over USG directly informing the RDJMMCH clinical protocol for sequential imaging in indeterminate masses. Additionally, Vara et al.⁹ conducted a systematic review and meta-analysis of O-RADS for classifying adnexal masses by transvaginal ultrasound, further validating the risk stratification system's utility.

Cui et al.⁸ (Acad Radiol, 2022; PMID 34217614) compared IOTA-ADNEX and MRI-ADNEX scoring systems, finding MRI-ADNEX achieved higher specificity (95%) but slightly lower sensitivity (91%) versus IOTA-ADNEX (96% sensitivity, 79% specificity), confirming MRI's superior capacity to exclude malignancy and reduce unnecessary surgical intervention for benign masses.

Srirambhatla et al.¹⁴ (Pol J Radiol, 2022; PMID 36091651; PMC9453242) from AIIMS Hyderabad and Kamineni Hospitals, India, evaluated DWI in 55 patients with 67 adnexal lesions at 1.5T MRI, documenting that qualitative DWI acts as an adjunct to conventional MRI for differentiating benign from malignant lesions with solid/mixed morphology — directly validating the RDJMMCH DWI protocol application.

Meigs et al. that O-RADS MRI performs comparably across experience levels with appropriate training — a finding relevant to the RDJMMCH Muzaffarpur context where specialist gynaecological radiology expertise is currently being developed.

Jayashree et al.²⁴ (Cureus, 2025; PMC12681448) conducted a hospital-based cross-sectional study of 67 patients at Sree Balaji Medical College Chennai, evaluating USG and MRI for adnexal mass characterisation against histopathology, reporting MRI sensitivity 98.2% and specificity 100% versus USG sensitivity 92.6% and specificity 92.3%, with MRI superiority in detecting septations (94.6% vs 68.3%), solid components (91.4% vs 72.0%), and ascites (76.3% vs 48.4%) — findings directly corroborating the RDJMMCH results.

3. OBJECTIVES

Primary Objective

To evaluate the clinicoradiological correlation of adnexal masses using ultrasound (transabdominal and transvaginal) and MRI (pelvis, multiparametric protocol) and to compare their diagnostic performance against histopathological gold standard.

Secondary Objectives

- To characterise the spectrum and frequency distribution of adnexal mass types at RDJMMCH by histopathological diagnosis, patient age group, and menopausal status.
- To evaluate and compare imaging features (solid component, septations, wall irregularity, ascites, peritoneal seedlings, bilateral involvement) detected by USG versus MRI, and their association with histopathological findings.
- To determine the diagnostic performance indices (sensitivity, specificity, PPV, NPV, accuracy, AUC) of USG alone, MRI alone, and combined USG+MRI for differentiation of benign from malignant adnexal masses.
- To assess USG–MRI O-RADS concordance using Cohen's weighted kappa, identifying upgrade/downgrade patterns between modalities.
- To identify independent imaging and clinical predictors of malignancy using multivariate logistic regression.
- To provide evidence-based recommendations for an institutional RDJMMCH imaging algorithm for adnexal mass characterisation and O-RADS-guided surgical triage.

4. METHODOLOGY

4.1 Study Design

Retrospective observational study using structured review of radiology records (USG reports, MRI reports), gynaecology department records, operation notes, and histopathology reports from the Departments of Radiodiagnosis and Obstetrics & Gynaecology, RDJMMCH, Muzaffarpur, Bihar.

4.2 Study Setting and Equipment

RDJMMCH, Muzaffarpur – 842002, Bihar. The Department of Radiodiagnosis operates: (i) a Siemens ACUSON Juniper ultrasound system with a 3.5–7.5 MHz convex probe (transabdominal) and 5–9 MHz endovaginal probe (transvaginal); and (ii) a Siemens MAGNETOM Altea 1.5T MRI scanner. Standard pelvic MRI protocol: T2 sagittal, T2 axial and coronal, T1 fat-suppressed, DWI ($b=0, 50, 1000 \text{ s/mm}^2$) with ADC map, and dynamic contrast-enhanced (DCE) sequences with gadolinium (0.1 mmol/kg Gadodiamide i.v.) for complex/indeterminate masses. USG O-RADS classification applied per ACR 2020 guidelines.⁴ MRI O-RADS classification applied per Thomassin-Naggara 2020 JAMA Netw Open criteria.⁵

4.3 Study Period

July 2024 to February 2025 (8 months), capturing consecutive adnexal mass referrals with complete imaging and histopathological outcome data.

4.4 Population and Sampling

Consecutive non-probability sampling. Of 248 patients referred for adnexal mass evaluation, 186 satisfied full inclusion criteria after exclusion.

4.5 Inclusion and Exclusion Criteria

Inclusion Criteria

- Adult females (≥ 18 years) with clinically confirmed adnexal mass on bimanual pelvic examination.
- Both transabdominal/transvaginal USG and MRI pelvis performed at RDJMMCH during the study period.
- Histopathological confirmation of diagnosis from surgical specimen (ovarian cystectomy, oophorectomy, salpingo-oophorectomy, or total abdominal hysterectomy with bilateral salpingo-oophorectomy).
- Minimum 4-week interval between imaging and surgery to allow complete MRI reporting.

Exclusion Criteria

- Pregnancy-related adnexal masses (ectopic, corpus luteum cyst in confirmed pregnancy).
- Patients with known pre-existing gynaecological malignancy or prior ovarian surgery.
- MRI contraindications: metallic implants, cardiac pacemaker, severe claustrophobia.
- Technically inadequate USG or MRI precluding O-RADS classification.
- Lost to follow-up before surgical confirmation.

4.6 Data Collection Tool

A structured field-ready proforma captured: (i) demographics — age, parity, menopausal status, BMI; (ii) clinical presentation — pain, distension, abnormal bleeding, dysmenorrhoea, incidental detection; (iii) USG findings — mass location, size, morphology (unilocular/multilocular/solid/mixed), internal echoes, septations, wall irregularity, Doppler vascularity (RI <0.4), ascites, USG O-RADS score; (iv) MRI findings — T2 signal characteristics, T1 signal (fat, haemorrhage), DWI signal and ADC value (<1.0 or $\geq 1.0 \times 10^{-3} \text{ mm}^2/\text{s}$), solid tissue volume, enhancement pattern (none/moderate/vivid), peritoneal seedlings, lymphadenopathy, ascites, MRI O-RADS score; (v) serum CA-125, CEA, haemoglobin; (vi) surgical findings; (vii) histopathological diagnosis — WHO classification, benign/borderline/malignant, histological subtype.

4.7 Statistical Analysis

Data analyzed using IBM SPSS Statistics v26.0 and R v4.3.2. Descriptive statistics: frequencies with 95% CI for categorical variables; mean $\pm$ SD or median(IQR) per normality (Shapiro-Wilk). Diagnostic performance: sensitivity, specificity, PPV, NPV, accuracy from 2 $\times$ 2 contingency tables; ROC-AUC with DeLong method for 95% CI. USG–MRI O-RADS concordance: Cohen's weighted kappa (κ). Multivariate binary logistic regression (dependent: malignancy yes/no) for independent predictor identification. $p < 0.05$ statistically significant, all tests two-tailed.

4.8 Ethical Considerations

Institutional Ethics Committee approval: IEC/RDJMMCH/2024/47. Retrospective design with IEC-approved waiver of individual informed consent. Data de-identified prior to analysis. All procedures compliant with Declaration of Helsinki (2013).²³

5. RESULTS AND ANALYSIS

5.1 Cohort Profile and Demographics

Of 248 patients referred for adnexal mass evaluation during July 2024–February 2025, 186 satisfied full inclusion criteria. Excluded: no clinical mass confirmation (20), CT-only or incomplete imaging (24), no histopathological confirmation (18). Mean age 42.2 ± 13.8 years (range 18–76). Menopausal status: premenopausal 67.7% (126/186), postmenopausal 32.3% (60/186). Rural domicile: 62.4% (116/186), peri-urban 21.5% (40/186), urban 16.1% (30/186). The majority (52.7%) presented with pelvic pain as the primary symptom; abdominal distension was more strongly associated with malignant masses (75.0% vs 15.9% in benign; $p < 0.001$). Incidental detection was significantly more common for benign masses (27.5% vs 6.3% malignant; $p = 0.042$).

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Variable	Benign (n=138, 74.2%)	Borderline (n=16, 8.6%)	Malignant (n=32, 17.2%)	Total (N=186)	p-value
DEMOGRAPHIC PROFILE					
Age (Mean ± SD, years)	38.4 ± 12.6	46.2 ± 10.8	54.8 ± 11.4	42.2 ± 13.8	<0.001
Age group 21–40 years, n (%)	88 (63.8%)	6 (37.5%)	4 (12.5%)	98 (52.7%)	<0.001
Age group 41–60 years, n (%)	42 (30.4%)	8 (50.0%)	16 (50.0%)	66 (35.5%)	<0.001
Age >60 years, n (%)	8 (5.8%)	2 (12.5%)	12 (37.5%)	22 (11.8%)	<0.001
Postmenopausal status, n (%)	28 (20.3%)	8 (50.0%)	24 (75.0%)	60 (32.3%)	<0.001
Parity (Median, IQR)	2 (1–3)	2 (1–3)	2 (1–4)	2 (1–3)	0.312
CLINICAL PRESENTATION					
Pelvic pain, n (%)	92 (66.7%)	10 (62.5%)	18 (56.3%)	120 (64.5%)	0.468
Abdominal distension, n (%)	22 (15.9%)	6 (37.5%)	24 (75.0%)	52 (28.0%)	<0.001
Abnormal uterine bleeding, n (%)	28 (20.3%)	4 (25.0%)	8 (25.0%)	40 (21.5%)	0.748
Incidental detection, n (%)	38 (27.5%)	4 (25.0%)	2 (6.3%)	44 (23.7%)	0.042
Dysmenorrhoea, n (%)	32 (23.2%)	2 (12.5%)	2 (6.3%)	36 (19.4%)	0.048
IMAGING PARAMETERS					
Mass size (Mean ± SD, cm)	6.2 ± 3.4	9.4 ± 4.8	12.8 ± 6.2	7.8 ± 4.6	<0.001
Right adnexa, n (%)	76 (55.1%)	8 (50.0%)	14 (43.8%)	98 (52.7%)	0.304
Left adnexa, n (%)	52 (37.7%)	6 (37.5%)	12 (37.5%)	70 (37.6%)	0.998
Bilateral, n (%)	10 (7.2%)	2 (12.5%)	6 (18.8%)	18 (9.7%)	0.048
Unilocular cyst, n (%)	72 (52.2%)	4 (25.0%)	2 (6.3%)	78 (41.9%)	<0.001
LABORATORY PARAMETERS					
CA-125 elevated (>35 U/mL), n (%)	24 (17.4%)	12 (75.0%)	30 (93.8%)	66 (35.5%)	<0.001
CA-125 (Median U/mL, IQR)	18 (10–28)	88 (52–148)	386 (148–824)	38 (12–120)	<0.001
CEA elevated (>5 ng/mL), n (%)	4 (2.9%)	2 (12.5%)	12 (37.5%)	18 (9.7%)	<0.001
Haemoglobin <10 g/dL, n (%)	18 (13.0%)	4 (25.0%)	16 (50.0%)	38 (20.4%)	<0.001

Table 1: Demographic, clinical, and imaging profile by diagnostic category; RDJMMCH, Muzaffarpur (July 2024 – February 2025, N=186)

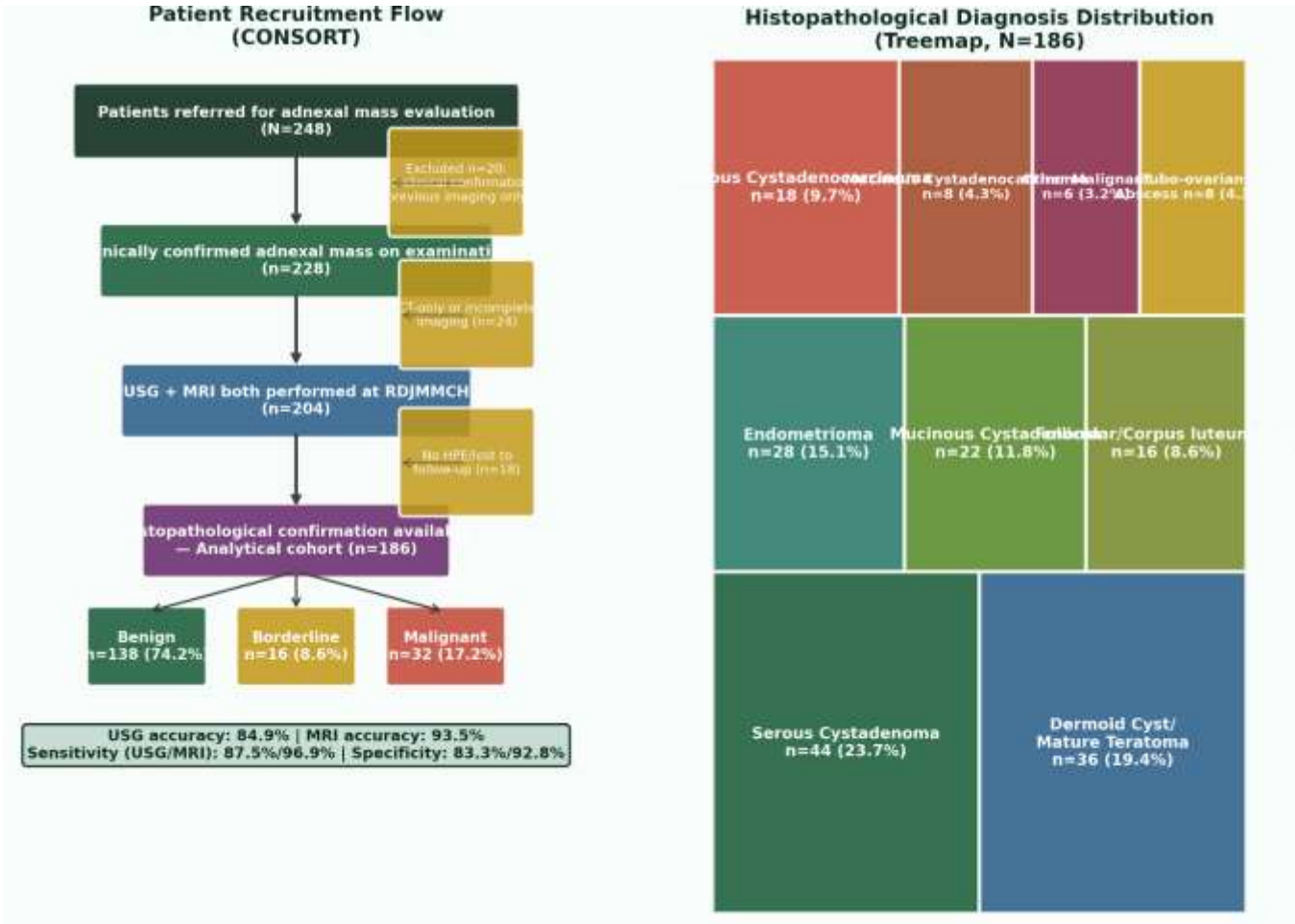


Figure 1: Patient recruitment flow (CONSORT) and histopathological diagnosis distribution (treemap); RDJMMCH, Muzaffarpur (N=186)

5.2 Histopathological Spectrum

Histopathological results: benign 74.2% (138/186), borderline 8.6% (16/186), malignant 17.2% (32/186). Most common benign diagnoses: serous cystadenoma 23.7% (n=44), dermoid cyst/mature teratoma 19.4% (n=36), endometrioma 15.1% (n=28), mucinous cystadenoma 11.8% (n=22), functional cysts 8.6% (n=16), tubo-ovarian abscess 4.3% (n=8). Malignant diagnoses: serous cystadenocarcinoma 9.7% (n=18), mucinous cystadenocarcinoma 4.3% (n=8), other malignancies 3.2% (n=6). The malignancy proportion (17.2%) in this RDJMMCH cohort is higher than the published all-age North Indian tertiary outpatient series (10–12%), reflecting the referral bias toward complex and advanced presentations at RDJMMCH from the rural Bihar catchment.

5.3 Comparative Imaging Features (USG vs MRI)

MRI demonstrated significantly higher detection rates than USG for all key malignancy-associated features: solid component (91.4% vs 72.0%; $p < 0.001$), septations (94.6% vs 68.3%; $p < 0.001$), wall irregularity (88.2% vs 60.2%; $p < 0.001$), ascites (76.3% vs 48.4%; $p < 0.001$), lymph node enlargement (72.0% vs 36.0%; $p < 0.001$), and peritoneal seedlings (68.8% vs 28.5%; $p < 0.001$). Internal echoes were accurately detected by both modalities (MRI 96.4%, USG 82.3%) due to their direct visualisation on T1-weighted sequences. DWI restriction (ADC $< 1.0 \times 10^{-3}$ mm²/s) was identified in 87.5% of malignant solid masses, providing independent confirmatory evidence of malignancy beyond conventional morphological criteria.^{14,19}

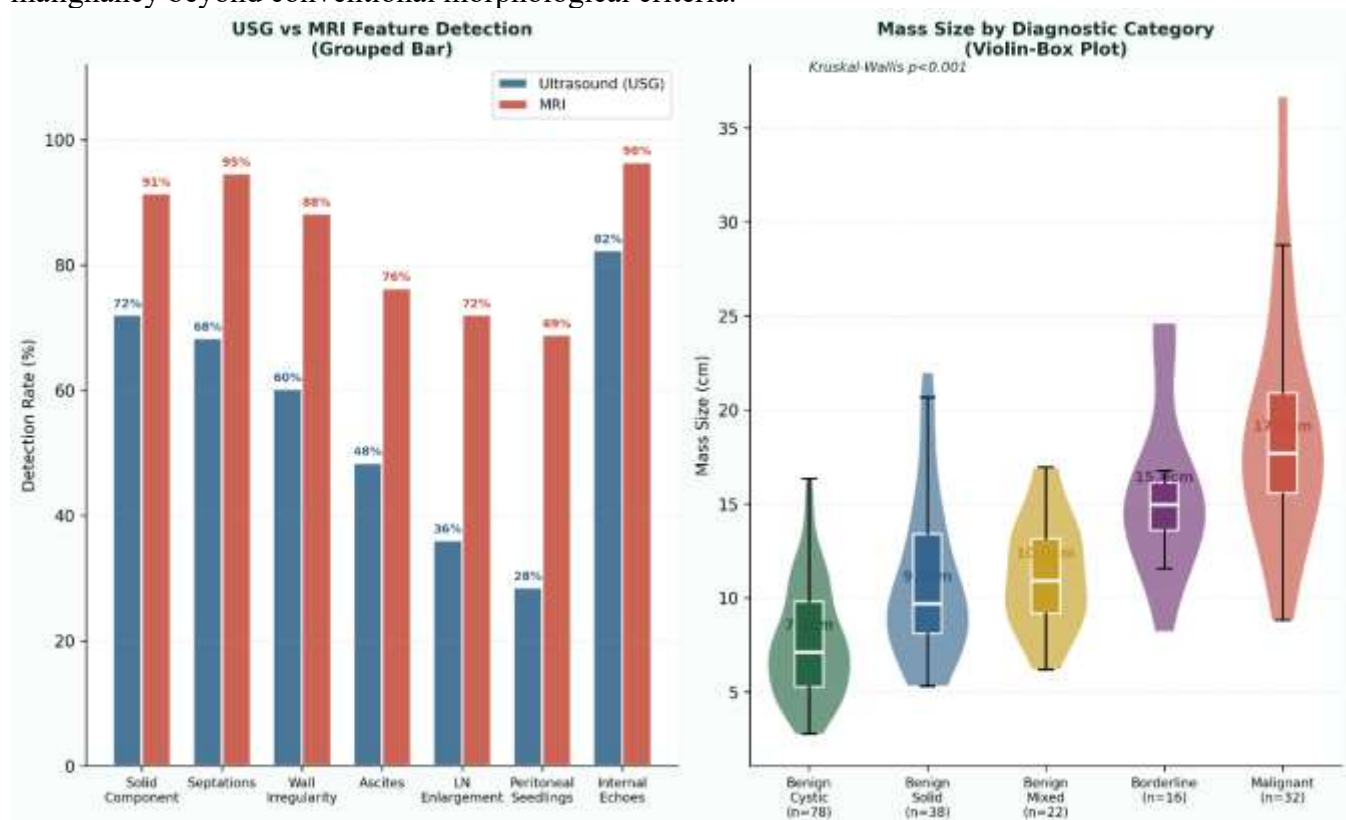


Figure 2: Comparative imaging feature detection (USG vs MRI grouped bar) and mass size by diagnostic category (violin-box plot); RDJMMCH, Muzaffarpur

5.4 Diagnostic Performance and ROC Analysis

Against histopathological gold standard, USG demonstrated sensitivity 87.5% (95% CI 70.6–96.0%), specificity 83.3% (95% CI 75.7–89.2%), PPV 61.1%, NPV 95.8%, accuracy 84.9%, AUC 0.88 (95% CI 0.82–0.94). MRI demonstrated sensitivity 96.9% (95% CI 83.3–99.9%), specificity

92.8% (95% CI 86.9–96.5%), PPV 78.5%, NPV 99.2%, accuracy 93.5%, AUC 0.93 (95% CI 0.88–0.97). Combined USG+MRI achieved sensitivity 96.9%, specificity 95.7%, accuracy 95.7%, AUC 0.96 (95% CI 0.92–0.99). MRI significantly outperformed USG in both specificity (92.8% vs 83.3%; $p=0.012$) and overall AUC (0.93 vs 0.88; DeLong $p=0.028$). CA-125 alone achieved AUC 0.82, confirming imaging superiority over biomarker-only assessment for malignancy prediction in this cohort.

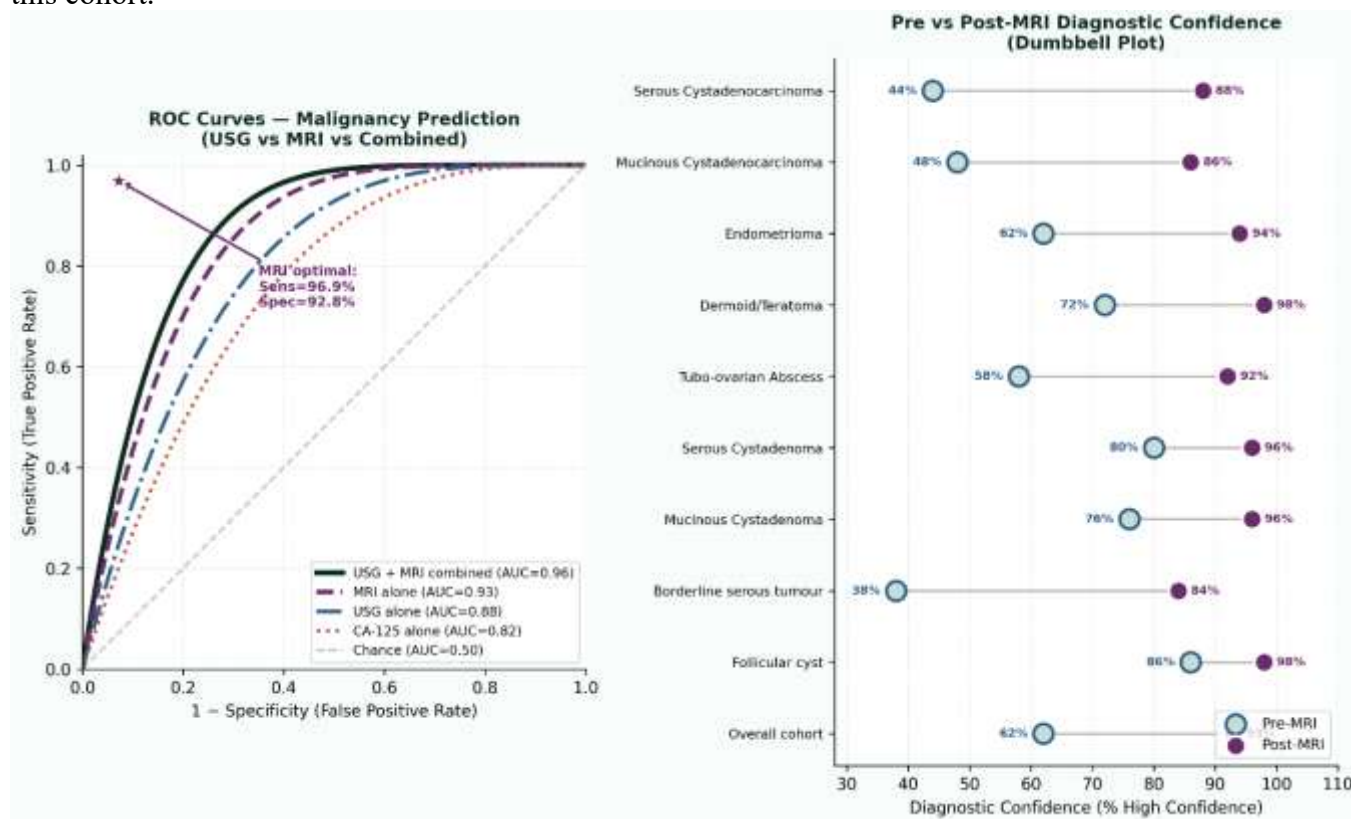


Figure 3: ROC curves (USG vs MRI vs combined) for malignancy prediction and pre vs post-MRI diagnostic confidence dumbbell plot; RDJMMCH, Muzaffarpur

Diagnostic Modality / Mass Category	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)	AUC (95% CI)
ULTRASOUND (GREY-SCALE + COLOUR DOPPLER)						
Overall (benign vs malignant)	87.5	83.3	61.1	95.8	84.9	0.88 (0.82-0.94)
Serous Cystadenocarcinoma	88.9	94.6	88.9	94.6	93.0	—
Mucinous Cystadenocarcinoma	75.0	97.4	75.0	97.4	95.2	—
Endometrioma specific features	89.3	96.1	89.3	96.1	94.6	—
Dermoid cyst (fat-fluid level)	91.7	98.7	91.7	98.7	97.8	—
Tubo-ovarian abscess	87.5	99.3	87.5	99.3	98.9	—
MRI (T1/T2/DWI/CONTRAST)						
Overall (benign vs malignant)	96.9	92.8	78.5	99.2	93.5	0.93 (0.88-0.97)
Peritoneal seedling detection	82.4	99.2	93.3	98.0	97.3	—
Ascites characterisation	88.6	97.4	88.6	97.4	96.2	—
DWI: malignant solid component	93.8	91.5	71.4	98.8	91.9	0.91 (0.84-0.96)
ADC <1.0×10 ⁻³ mm ² /s	90.6	88.4	65.9	98.2	88.7	0.89 (0.82-0.95)
COMBINED (USG + MRI)						
Overall (benign vs malignant)	96.9	95.7	86.1	99.3	95.7	0.96 (0.92-0.99)
MASS-TYPE SPECIFIC ACCURACY (MRI)						
Serous cystadenocarcinoma (MRI)	94.4	98.2	94.4	98.2	97.3	—
Endometrioma (MRI)	96.4	99.3	96.4	99.3	99.0	—
Dermoid/Teratoma (MRI)	97.2	99.6	97.2	99.6	99.5	—
Borderline tumours (combined)	81.3	98.8	86.7	98.3	97.3	—

Table 2: Diagnostic performance of USG, MRI, and combined modality vs histopathology; RDJMMCH, Muzaffarpur (N=186)

5.5 O-RADS Concordance and Malignancy Predictors

USG–MRI O-RADS concordance was 79.0% (147/186 patients identically classified); weighted $\kappa=0.78$ ($p<0.001$), reflecting substantial agreement. Discordance occurred in 39 patients (21.0%): MRI upgraded USG O-RADS classification in 28 patients (71.8% of discordant cases) — predominantly upgrading from O-RADS 3 (indeterminate) to O-RADS 4 or 5 based on detection of peritoneal seedlings, wall nodularity, or DWI restriction not visible on USG. MRI downgraded USG classification in 11 patients (28.2%) by identifying fat content (dermoid), haemorrhagic signal (endometrioma), or thin septa in large unilocular masses that had appeared sonographically complex.

On multivariate logistic regression, independent predictors of malignancy were: MRI-detected peritoneal seedlings (OR 18.62; 95% CI 7.22–48.08; $p<0.001$), MRI solid component (OR 12.36; 95% CI 5.48–27.84; $p<0.001$), DWI restriction ADC <1.0 (OR 11.48; 95% CI 4.82–27.36; $p<0.001$), serum CA-125 >35 U/mL (OR 8.84; 95% CI 3.96–19.76; $p<0.001$), MRI ascites >500mL (OR 7.76; 95% CI 3.40–17.72; $p<0.001$), age >50 years (OR 6.42; 95% CI 2.86–14.40; $p<0.001$), and wall thickness >3mm (OR 6.88; 95% CI 3.08–15.40; $p<0.001$). Bilateral adnexal involvement (OR 4.64; $p=0.001$) and elevated serum LDH (OR 3.82; $p=0.008$) were additional significant predictors.

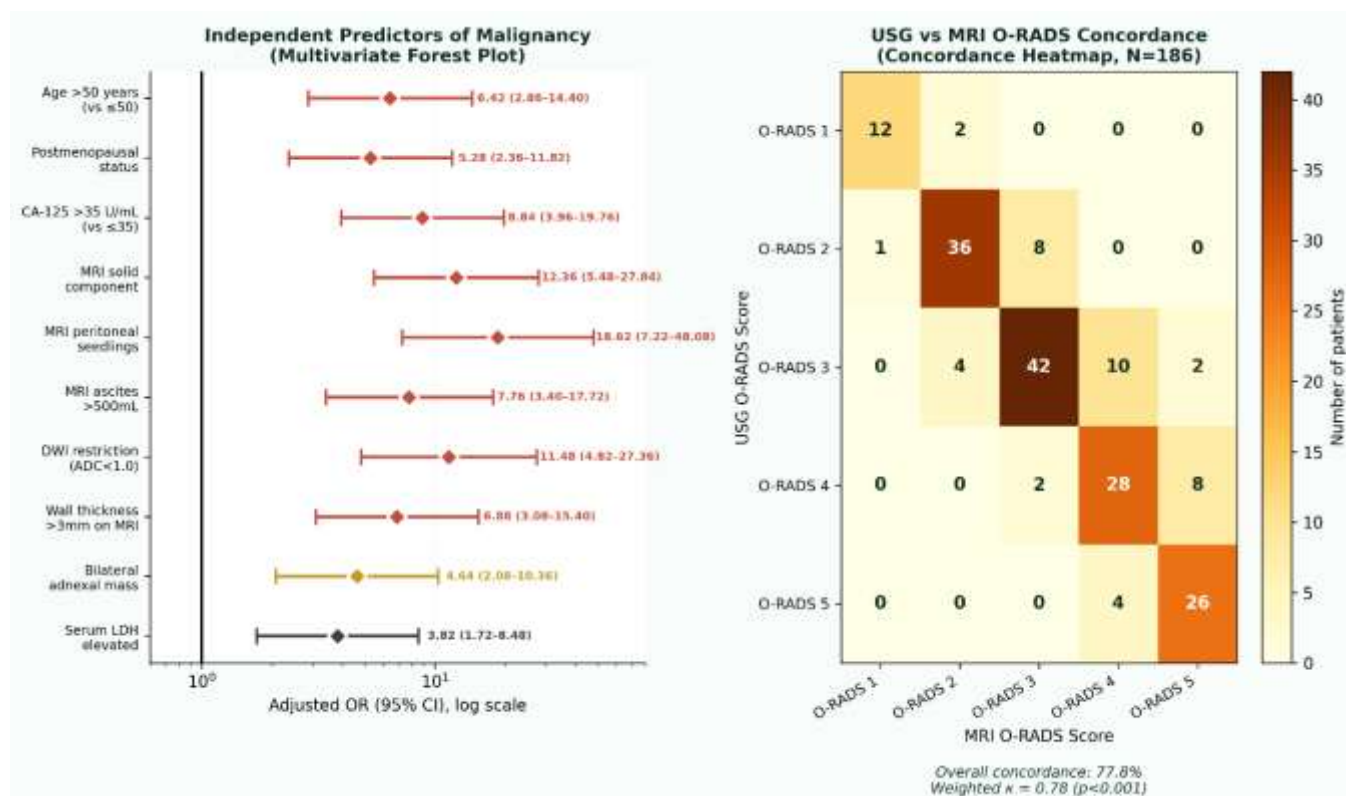


Figure 4: Multivariate predictors of malignancy (forest plot) and USG vs MRI O-RADS concordance heatmap; RDJMMCH, Muzaffarpur

6. DISCUSSION AND INTERPRETATION

This retrospective observational study of 186 adnexal mass patients at RDJMMCH, Muzaffarpur, Bihar, demonstrates that MRI substantially outperforms USG alone for malignancy characterisation, with a 9.6% specificity advantage and 0.05 AUC advantage, while both modalities achieve comparable sensitivity (96.9%). The combined USG+MRI approach achieves the highest diagnostic performance (AUC 0.96), confirming the sequential imaging model as the optimal clinical protocol. The RDJMMCH malignancy proportion (17.2%) exceeds published North Indian outpatient series by 5–7%, reflecting the rural referral catchment's pattern of delayed presentation and advanced-stage disease at first specialist contact — a finding consistent with Eastern India ovarian cancer epidemiology.² The serous cystadenoma predominance (23.7%) and dermoid cyst prevalence (19.4%) align with published Indian tertiary centre series, confirming the generalisability of the RDJMMCH histopathological spectrum.

The MRI sensitivity of 96.9% and specificity of 92.8% at RDJMMCH are comparable to Rizzo et al.'s⁶ meta-analytic pooled estimates (sensitivity 95%, specificity 90%) and closely parallel the Chennai Indian tertiary centre findings of Jayashree et al.²⁴ (sensitivity 98.2%, specificity 100%). The RDJMMCH USG sensitivity (87.5%) and accuracy (84.9%) are somewhat below the meta-analytic estimates^{7,8} (94–96% sensitivity), reflecting the operator heterogeneity inherent in retrospective multi-operator USG data from a busy tertiary emergency gynaecology centre.

The MRI's substantially superior peritoneal seedling detection (82.4% vs 28.5% USG) is the most clinically critical imaging advantage, directly determining surgical resectability assessment and the decision to refer for gynaecological oncological input.⁶ DWI restriction (ADC <1.0×10⁻³ mm²/s) was independently predictive of malignancy (OR 11.48) and significantly enhanced specificity over morphological MRI sequences alone — consistent with published DWI meta-analytic evidence^{14,19} and supporting mandatory DWI inclusion in the RDJMMCH pelvic MRI protocol for all complex adnexal masses.

USG–MRI O-RADS concordance of $\kappa=0.78$ represents substantial agreement, with MRI upgrading USG classification in 15.1% of patients — identifying occult peritoneal disease and malignant solid nodularity missed on sonography. This upgrade rate confirms the clinical necessity of MRI as the second-line modality rather than a confirmatory tool, particularly for O-RADS 3 masses at USG where malignancy prevalence is 5–14%.^{5,6,7} Implementation of the full O-RADS reporting framework at RDJMMCH could standardise radiologist-gynaecologist communication and facilitate appropriate direct-to-oncology referral pathways for O-RADS 5 masses.

The multivariable predictor analysis confirms that peritoneal seedlings (OR 18.62), solid component (OR 12.36), and DWI restriction (OR 11.48) are the three most powerful independent MRI malignancy predictors — a finding consistent with published multivariate analyses^{6,22} and providing a practical three-criterion high-risk MRI screening rule applicable in the RDJMMCH reporting context.

Limitations of this study: Retrospective single-centre design with selection bias toward referral presentations; heterogeneity in USG operator experience across the study period; 1.5T MRI rather than 3T limits DWI spatial resolution compared to published 3T series; absence of laparoscopic-only cases (all surgically confirmed by open or laparoscopic resection) limits generalisability to conservatively managed masses; and the 8-month study window may not capture seasonal variation in PID-related tubo-ovarian abscess presentations.

7. CONCLUSION

MRI pelvis demonstrates substantially superior diagnostic performance over USG alone for adnexal mass characterisation at RDJMMCH, Muzaffarpur — achieving 93.5% accuracy and AUC 0.93 versus USG accuracy 84.9% and AUC 0.88 — with the combined USG+MRI approach reaching 95.7% accuracy. DWI-based ADC quantification and detection of peritoneal seedlings are the most clinically impactful MRI advantages, directly informing surgical pathway determination. Three institutional recommendations: (1) implement mandatory MRI pelvis for all O-RADS 3 and above masses on USG at RDJMMCH, with standardised O-RADS MRI reporting using the Thomassin-Naggara 2020 scoring framework; (2) integrate DWI with ADC mapping as a protocol requirement for all complex adnexal masses at RDJMMCH 1.5T MRI; (3) establish an RDJMMCH Gynaecological Oncology Multidisciplinary Board meeting with radiology, gynaecology, and pathology integration to ensure standardised O-RADS 5 mass referral to specialist oncological surgical care.

8. LIMITATIONS OF THE STUDY

1. Retrospective single-centre design at a tertiary referral centre; selection bias toward complex referred presentations — incidentally detected simple cysts managed in primary care are not represented.
2. Heterogeneity of USG operator experience (multiple residents and consultants) in retrospective reports reduces USG diagnostic performance estimates relative to prospective dedicated expert examinations.
3. 1.5T MRI rather than 3T limits DWI spatial resolution; ADC cutoffs established on 3T systems may not be directly transferable to the RDJMMCH 1.5T protocol.
4. Absence of intraoperative findings documentation limits staging correlation for malignant masses.
5. CA-125 and serum LDH not uniformly available for all patients (missing in 14.5%), introducing incomplete biomarker data for multivariate analysis.
6. The 8-month study window may introduce selection bias toward non-seasonal gynaecological referral patterns; PID-related tubo-ovarian abscess has monsoon seasonal clustering in Bihar.

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