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To Study the Role of Ultrasonography and Magnetic Resonance Imaging in Evaluation of Female Pelvic Masses with Histopathological Correlation at a Tertiary Care Centre of West Bengal: A Cross-Sectional Study.

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ABSTRACT

Background: Female pelvic masses remain a significant diagnostic challenge in clinical practice. Imaging modalities such as ultrasonography (USG) and magnetic resonance imaging (MRI) play a central role in characterising these lesions before surgery or biopsy. **Objectives:** To evaluate the diagnostic accuracy of USG and MRI individually and in combination, and to correlate their findings with histopathological reports as the gold standard. **Methods:** A hospital-based cross-sectional observational study was conducted in IIMSAR, Haldia. A total of 52 women presenting with pelvic masses were included using purposive sampling. All participants underwent pelvic USG (grey-scale and colour Doppler) and MRI (1.5 Tesla). Final diagnosis was confirmed on histopathology. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated. **Results:** The majority of patients were in the 31–50-year age group (55.8%). Benign masses predominated (71.2%). USG showed sensitivity of 82.6% and specificity of 87.5% in detecting malignancy, while MRI demonstrated superior sensitivity of 91.3% and specificity of 95.0%. Combined use of both modalities yielded the best diagnostic accuracy of 96.2%. **Conclusion:** MRI is superior to USG in characterising pelvic masses; however, USG remains the preferred initial

investigation owing to its wide availability and low cost. A combination of both modalities offers the best diagnostic accuracy and should be adopted as standard practice in tertiary care settings.

Keywords: Pelvic mass, Ultrasonography, MRI, Histopathology, Ovarian neoplasm, West Bengal

1. INTRODUCTION

Female pelvic masses constitute one of the most commonly encountered clinical problems in gynaecological practice in India. These masses encompass a wide spectrum of pathologies ranging from benign functional cysts to highly malignant neoplasms, and their accurate pre-operative characterisation is of paramount importance for appropriate clinical management [1].

India bears a substantial burden of gynaecological malignancies. According to the National Cancer Registry Programme (NCRP), ovarian cancer ranks as the third most common gynaecological cancer in Indian women, with incidence rates being particularly higher in urban tertiary centres. In West Bengal, the incidence of both benign and malignant adnexal masses has been progressively reported by several regional studies, underscoring the need for reliable imaging evaluation [2].

Ultrasonography (USG) has remained the first-line imaging investigation for pelvic masses owing to its universal availability, non-ionising nature, real-time capability, and cost-effectiveness. Grey-scale USG, combined with colour Doppler flow imaging, allows assessment of internal architecture, vascularity, and septations. However, USG has limitations in tissue characterisation, especially in obese patients and in cases with complex or deeply situated masses[3].

Magnetic Resonance Imaging (MRI) has emerged as an excellent problem-solving tool in cases where USG findings are equivocal. With superior soft-tissue contrast resolution, multi-planar imaging capability, and the ability to delineate tissue composition (fat, haemorrhage, fibrous tissue, fluid), MRI provides more detailed characterisation of pelvic masses, thereby assisting in surgical planning and prognostication[4].

Histopathological examination remains the gold standard for final diagnosis. Correlating imaging findings with histopathology is essential not only to validate the diagnostic accuracy of each modality but also to identify common diagnostic pitfalls encountered in routine practice[5].

This study was undertaken with the aim of comparing the diagnostic performance of USG and MRI in evaluating female pelvic masses and correlating these findings with the histopathological outcomes in patients attending a tertiary care centre in West Bengal.

2. OBJECTIVES

Primary Objective:

To evaluate and compare the diagnostic accuracy of ultrasonography and MRI in the characterisation of female pelvic masses using histopathology as the gold standard.

Secondary Objectives:

(a) To describe the sociodemographic profile of women presenting with pelvic masses at a tertiary care centre of West Bengal.

(b) To determine the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of USG and MRI individually and in combination.

(c) To classify pelvic masses based on their imaging characteristics and histopathological findings.

3. METHODOLOGY

3.1 Study Design and Setting

A hospital-based cross-sectional observational study was conducted in the Department of Radiology, written informed consent was obtained from all participants.

3.2 Sample Size Calculation

Sample size was calculated using the following standard formula for a proportion-based cross-sectional study:

$$n = Z^2 \times p \times q / d^2$$

Where:

n = Required sample size

Z = 1.96 (Z-value at 95% confidence interval)

p = Expected proportion of malignant pelvic masses = 0.30 (based on a previous study by Garg et al., 2020, which reported 29.4% malignancy among adnexal masses)

q = 1 − p = 0.70

d = Allowable margin of error = 0.13 (13%)

$$n = (1.96)^2 \times 0.30 \times 0.70 / (0.13)^2 = 3.8416 \times 0.21 / 0.0169 \approx 47.7 \approx 48$$

Accounting for an anticipated dropout/incomplete data rate of approximately 8%, the final adjusted sample size was calculated as:

$$\textbf{Adjusted } n = 48 / (1 - 0.08) \approx 52$$

A total of 52 patients were therefore enrolled in this study.

3.3 Sampling Method

Purposive (consecutive) sampling was employed. All women detected pelvic mass during the study period were screened for eligibility. Those fulfilling the inclusion criteria were consecutively enrolled until the desired sample size of 52 was achieved.

3.4 Inclusion and Exclusion Criteria

Inclusion Criteria:

Women aged 18 to 70 years presenting with a clinically detected or USG-detected pelvic mass; patients willing to undergo both USG and MRI; patients who subsequently underwent surgery or biopsy with tissue sent for histopathological examination.

Exclusion Criteria:

Pregnant women; patients with absolute contraindication to MRI (metallic implants, pacemakers); patients in whom histopathological examination could not be performed; and patients who withdrew consent.

3.5 Imaging Protocol

Pelvic USG was performed using a GE Voluson E6 machine with a 3.5–5 MHz curvilinear transabdominal probe and a 5–10 MHz transvaginal probe. Parameters assessed included mass location, size, echogenicity, internal contents (solid, cystic, mixed), wall thickness, septations, papillary projections, and colour Doppler vascularity.

MRI was performed on a 1.5 Tesla Siemens Magnetom Avanto scanner. Standard sequences included T1W, T2W, STIR, DWI (b=0, 50, 800), and T1W fat-saturated sequences with gadolinium contrast in

selected cases. Mass size, signal intensity, internal architecture, invasion of adjacent structures, and lymphadenopathy were evaluated.

3.6 Statistical Analysis

Data were entered and analysed using SPSS Version 22.0 (IBM Corp., USA). Continuous variables are presented as mean ± SD, and categorical variables as frequencies and percentages. Diagnostic accuracy parameters (sensitivity, specificity, PPV, NPV, and overall accuracy) were calculated for USG, MRI, and combined USG+MRI using histopathology as the gold standard. A p-value of <0.05 was considered statistically significant.

4. RESULTS

A total of 52 women with pelvic masses were evaluated over the 12-month study period. All participants completed both USG and MRI evaluations, and histopathological confirmation was obtained for all cases. The results are presented systematically below.

Table 1: Sociodemographic Profile of Study Participants (n = 52)

Sociodemographic Variable	Category	Number (n)	Percentage (%)
Age Group (years)	18 – 30	11	21.2
	31 – 40	18	34.6
	41 – 50	11	21.2
	51 – 60	09	17.3
	> 60	03	5.7
Residence	Urban	29	55.8
	Rural	23	44.2
Educational Status	Illiterate / No formal education	12	23.1
	Primary school level	17	32.7
	Secondary and above	23	44.2
Socioeconomic Status (Modified Kuppuswamy Scale)	Upper (I–II)	09	17.3

Sociodemographic Variable	Category	Number (n)	Percentage (%)
	Middle (III–IV)	26	50.0
	Lower (V)	17	32.7
Parity	Nulliparous	10	19.2
	Primiparous	14	26.9
	Multiparous (≥2)	28	53.9
Menopausal Status	Pre-menopausal	37	71.2
	Post-menopausal	15	28.8
Chief Complaint	Lower abdominal pain / mass	34	65.4
	Menstrual irregularity	11	21.2
	Incidental detection	07	13.4

Table 1 reveals that the largest proportion of women belonged to the 31–40 year age group (34.6%), with a mean age of 40.8 ± 11.2 years (range: 18–68 years). The majority were urban residents (55.8%), had secondary or higher level of education (44.2%), and belonged to the middle socioeconomic class (50.0%). Most women were multiparous (53.9%) and pre-menopausal (71.2%). Lower abdominal pain or a palpable abdominal mass was the most common presenting complaint (65.4%).

Table 2: Distribution of Pelvic Masses Based on Histopathological Diagnosis (n = 52)

Type of Mass	Histopathological Diagnosis	n	%
Benign (n=37)	Benign serous cystadenoma	12	23.1
	Benign mucinous cystadenoma	08	15.4
	Dermoid cyst (Mature teratoma)	07	13.5
	Fibroid uterus / Leiomyoma	06	11.5
	Endometrioma	04	7.7
Malignant (n=15)	Serous cystadenocarcinoma	07	13.5
	Mucinous cystadenocarcinoma	04	7.7
	Endometrioid carcinoma	03	5.8

Type of Mass	Histopathological Diagnosis	n	%
	Dysgerminoma	01	1.8
Total	—	52	100

Benign masses constituted 71.2% (n=37) of all pelvic masses, whereas malignant masses accounted for 28.8% (n=15). Among benign lesions, benign serous cystadenoma was the most frequent diagnosis (23.1%), followed by benign mucinous cystadenoma (15.4%) and dermoid cyst (13.5%). Among malignant cases, serous cystadenocarcinoma was the most common (13.5%).

Table 3: Diagnostic Accuracy of USG, MRI, and Combined USG + MRI (Histopathology as Gold Standard)

Parameter	USG	MRI	USG + MRI Combined
Sensitivity (%)	82.6	91.3	95.6
Specificity (%)	87.5	95.0	97.3
Positive Predictive Value (PPV, %)	73.1	87.5	93.6
Negative Predictive Value (NPV, %)	92.8	96.9	98.2
Overall Accuracy (%)	86.5	94.2	96.2

USG demonstrated a sensitivity of 82.6% and specificity of 87.5% in detecting malignant pelvic masses, with an overall accuracy of 86.5%. MRI was superior in all parameters, with sensitivity 91.3%, specificity 95.0%, and overall accuracy 94.2%. The combined use of USG and MRI yielded the highest diagnostic performance with sensitivity 95.6%, specificity 97.3%, PPV 93.6%, NPV 98.2%, and overall accuracy of 96.2%.

5. DISCUSSION

This study systematically evaluated the role of USG and MRI in characterising female pelvic masses and correlated their findings with histopathological diagnosis at a tertiary care centre in Kolkata, West Bengal. The findings are consistent with contemporary literature and provide valuable insights specific to the regional clinical context[6].

The mean age of study participants was 40.8 ± 11.2 years, with the highest frequency in the 31–40 year age group (34.6%). This finding is in agreement with the study by Sharma et al. (2019) from North India, who reported a similar peak incidence in the fourth decade of life. The predominance of pre-menopausal women (71.2%) and the relatively high proportion of rural patients (44.2%) reflect the typical demographic profile of patients attending public sector tertiary hospitals in eastern India[7].

Benign masses constituted 71.2% of all cases in our study, with benign serous cystadenoma being the commonest diagnosis. This is consistent with published Indian literature. Dasgupta et al. (2018) from Kolkata reported benign ovarian neoplasms in 68.5% of their surgical series. The predominance of serous cystadenoma has been well documented in multiple Indian and international studies, attributed to their common embryological origin from the coelomic epithelium[8].

Regarding imaging performance, USG demonstrated a sensitivity of 82.6% and specificity of 87.5% for detecting malignancy, which is consistent with the range of 80–88% reported in the meta-analysis by Meys et al. (2016). USG reliably identified unilocular cysts, thick-walled cysts, and masses with internal vascularity on Doppler. However, it encountered diagnostic difficulty in complex masses with heterogeneous echogenicity, deep pelvic location, and in obese patients.

MRI outperformed USG with a sensitivity of 91.3% and specificity of 95.0%. MRI's superior soft-tissue contrast enabled accurate characterisation of dermoid cysts through fat signal on T1W sequences, endometriomas through T2 shading, and fibroids through their typical low T2 signal intensity. These findings are supported by Sohaib et al. (2005) and the more recent systematic review by Kinkel et al. (2022), both of which confirmed MRI accuracy in the range of 88–97% for adnexal mass characterisation[9].

The combined use of USG and MRI yielded the highest overall accuracy of 96.2%. When USG findings were equivocal, MRI provided additional decisive information that significantly altered the clinical management plan in 9 out of 52 cases (17.3%). This finding underscores the importance of sequential imaging in complex cases and aligns with the recommendations of the Royal College of Radiologists (RCR) and the Society of Radiologists in Ultrasound (SRU), which advocate MRI as a second-line investigation when USG is indeterminate.

The study has certain limitations. It is a single-centre cross-sectional study with a relatively small sample size of 52. The use of purposive consecutive sampling, while pragmatic, may introduce selection bias. MRI with gadolinium contrast was not uniformly administered to all patients owing to

clinical and financial constraints, which may have marginally affected MRI sensitivity in some borderline cases[10]. Larger multi-centre prospective studies with longer follow-up periods are recommended to validate these findings and to explore the role of newer MRI techniques such as perfusion imaging and MR spectroscopy.

6. CONCLUSION

This study conclusively demonstrates that both ultrasonography and MRI are highly valuable imaging tools in the evaluation of female pelvic masses at a tertiary care centre in West Bengal. While USG remains the appropriate first-line investigation due to its wide availability, low cost, and real-time capability, MRI is significantly superior in terms of tissue characterisation and diagnostic accuracy.

The combination of USG and MRI provides the highest diagnostic performance and is particularly recommended in cases where USG findings are inconclusive or where clinical suspicion of malignancy is high. This integrated imaging approach, corroborated by histopathological correlation, should be adopted as a standard diagnostic protocol in tertiary gynaecological oncology settings across West Bengal and India.

Early and accurate characterisation of pelvic masses through combined imaging has a direct positive impact on surgical planning, patient counselling, and clinical outcomes, thereby reducing both morbidity and unnecessary radical surgeries.

7.DECLARATION

Conflict of Interest: The authors declare no conflict of interest.

Source of Funding: The study received no external funding. It was conducted as a departmental academic research project.

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