Section: Miscellaneous

Original Research Article

OBSERVATIONAL STUDY OF ULTRASOUND FEATURES AND HISTOPATHOLOGICAL OUTCOMES IN PATIENTS WITH ADNEXAL MASSES

Manvi Harjai[1], Rajendra Singh Punia[2], Rachit Harjai[3], Isha Gupta[4], Deergha Singh[5]

[1]*Assistant Professor, Department of OBS & Gynae, NC Medical College & Hospital, Israna, Panipat, India.*
[2]*Assistant Professor, Department of Radiology, NC Medical College & Hospital, Israna, Panipat, India.*
[3]*Associate Professor, Department of Radiology, NC Medical College & Hospital, Israna, Panipat, India.*
[4]*Professor & Head, Department of Pathology, NC Medical College & Hospital, Israna, Panipat, India.*
[5]*Assistant Professor, Department of Pathology, NC Medical College & Hospital, Israna, Panipat, India.*

Received *: 11/04/2026*
Received in revised form *: 03/06/2026*
Accepted *: 18/06/2026*

Corresponding Author:
Dr. Rachit Harjai,
Associate Professor, Department of Radiology, NC Medical College & Hospital, Israna, Panipat, India.
Email: drrachitharjai@gmail.com

DOI: 10.70034/ijmedph.2026.2.670

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

Int J Med Pub Health
2026; 16 (2); 4072-4078

ABSTRACT

Background: Adnexal masses are commonly encountered in gynecological practice and include a wide spectrum of benign, borderline, and malignant lesions. Clinical features are often nonspecific, making preoperative differentiation difficult. Ultrasonography is widely used as the first-line imaging modality for assessment of adnexal masses because it provides important information regarding morphology, size, laterality, internal architecture, and vascularity. Correlation of ultrasound findings with histopathological diagnosis is essential to evaluate its diagnostic usefulness in clinical practice. **Aim:** To evaluate ultrasound features and their association with histopathological outcomes in patients with adnexal masses at a tertiary care hospital.

Materials and Methods: This observational study included 95 patients with clinically or radiologically suspected adnexal masses who underwent clinical evaluation, ultrasound assessment, surgical management, and histopathological examination. Demographic details, menopausal status, presenting symptoms, clinical findings, and ultrasound features including size, laterality, locularity, solid component, septations, papillary projections, ascites, Doppler vascularity, and resistance index were recorded. Histopathological diagnosis was considered the gold standard. Data were analyzed using IBM SPSS Statistics version 27.0. Categorical variables were expressed as frequency and percentage, and associations were assessed using Chi-square test or Fisher's exact test. A p-value <0.05 was considered statistically significant.

Results: Among 95 patients, 72 cases (75.79%) were benign, 5 cases (5.26%) were borderline, and 18 cases (18.95%) were malignant. Non-benign lesions were significantly associated with age >50 years and postmenopausal status (p<0.001). Abdominal distension, gastrointestinal or urinary symptoms, and weight loss or loss of appetite showed significant association with non-benign pathology. Ultrasound features such as tumor size ≥10 cm, bilaterality, multilocularity, solid component, thick septations, papillary projections, ascites, marked Doppler vascularity, and low resistance index were significantly associated with non-benign histopathological outcome. Ultrasound showed sensitivity of 86.96%, specificity of 91.67%, positive predictive value of 76.92%, negative predictive value of 95.65%, and diagnostic accuracy of 90.53% for detecting non-benign adnexal masses.

Conclusion: Ultrasonography is a reliable and effective modality for preoperative evaluation of adnexal masses. Suspicious ultrasound features show strong correlation with non-benign histopathology and help in risk stratification, surgical planning, and timely referral of suspected malignant cases.

Keywords: Adnexal mass; Ultrasonography; Histopathology; Ovarian tumor; Doppler vascularity.

INTRODUCTION

Adnexal masses are among the most frequently encountered clinical and radiological findings in gynecological practice. They may arise from the ovary, fallopian tube, paraovarian tissues, or surrounding pelvic structures, and include a wide spectrum of physiological, inflammatory, benign neoplastic, borderline, and malignant conditions. Their clinical significance lies in the difficulty of distinguishing benign lesions, which may require conservative or limited surgical management, from malignant lesions, which require timely referral, staging, and definitive oncological care. Because adnexal masses may be detected incidentally or may present with nonspecific symptoms such as pelvic pain, abdominal distension, menstrual disturbance, urinary complaints, or gastrointestinal discomfort, systematic evaluation is essential for appropriate management.[1] The initial assessment of an adnexal mass requires integration of clinical history, age, menopausal status, physical examination, imaging findings, and selected laboratory parameters. Premenopausal women commonly present with functional cysts, endometriomas, benign epithelial tumors, or inflammatory adnexal lesions, whereas the probability of malignancy increases after menopause. However, clinical examination alone has limited ability to define the nature of the lesion, especially when the mass is small, deep seated, complex, or associated with obesity, guarding, or pelvic adhesions. For this reason, imaging plays a central role in the diagnostic pathway. Current clinical guidance emphasizes that women with adnexal masses should undergo structured evaluation to identify those suitable for observation, routine surgery, or referral to a gynecologic oncology unit.[2] Ultrasonography is considered the first-line imaging modality for evaluation of adnexal masses because it is widely available, non-invasive, cost-effective, and capable of assessing both morphology and vascularity. Transabdominal ultrasonography provides a broader pelvic overview, while transvaginal ultrasonography offers superior resolution for adnexal characterization. Important grayscale parameters include lesion size, laterality, cystic or solid nature, locularity, wall thickness, septations, papillary projections, mural nodules, internal echogenicity, calcification, hemorrhagic content, and associated ascites. Doppler assessment further contributes by evaluating vascular distribution, flow pattern, and resistance characteristics. When these features are interpreted together, ultrasound can guide preoperative risk stratification and help clinicians plan the most appropriate surgical approach.[3] A major challenge in ultrasound assessment is variability in terminology and interpretation among observers. To reduce ambiguity, standardized reporting systems have been developed for adnexal lesions. The Ovarian-Adnexal Reporting and Data System ultrasound framework provides a structured lexicon and risk stratification system for describing adnexal masses and assigning a risk category based on sonographic appearance. Such standardization improves communication between radiologists, gynecologists, and oncologists, and helps ensure that similar lesions are described and managed consistently across clinical settings.[4] Structured ultrasound reporting is particularly valuable because many adnexal masses show overlapping features. Benign tumors may occasionally appear complex because of hemorrhage, torsion, infection, or degeneration, while malignant tumors may initially present as cystic lesions without obvious aggressive features. Therefore, classification systems such as O-RADS, IOTA Simple Rules, and related models aim to organize sonographic features into clinically meaningful categories. These tools do not replace clinical judgment but assist in decision-making by providing a reproducible framework for identifying masses that require follow-up, further imaging, surgical intervention, or oncological referral.[5] Despite advances in imaging, histopathological examination remains the definitive method for diagnosis. Surgical specimens allow confirmation of the exact pathological type, including benign epithelial tumors, germ cell tumors, sex cord-stromal tumors, endometriotic lesions, borderline tumors, and malignant ovarian neoplasms. Correlation between ultrasound impression and histopathological outcome is therefore important for assessing the practical diagnostic value of ultrasound in real-world hospital settings. Such correlation helps identify which ultrasound features are most strongly associated with malignancy and which features are more often linked with benign disease.[6]

MATERIALS AND METHODS

This observational study was conducted at a tertiary care hospital to evaluate the ultrasound features and histopathological outcomes in patients presenting with adnexal masses. The study included patients who underwent clinical evaluation, ultrasound examination, surgical management, and subsequent histopathological assessment of the adnexal mass. A total of 95 patients with clinically or radiologically suspected adnexal masses were included in the study. All eligible patients presenting to the gynecology outpatient department or admitted to the gynecology ward with an adnexal mass were evaluated. Patients were enrolled after obtaining informed consent and after fulfilling the required selection criteria.

Inclusion Criteria

Patients of reproductive, perimenopausal, or postmenopausal age groups who were diagnosed with an adnexal mass on clinical examination or ultrasound were included in the study. Patients who underwent operative intervention and had histopathological confirmation of the adnexal lesion were considered eligible for final analysis.

Exclusion Criteria

Patients with adnexal masses managed conservatively without histopathological confirmation were excluded from the study. Pregnant women with adnexal masses, patients with previously diagnosed ovarian malignancy, recurrent adnexal tumors, or incomplete clinical, radiological, or histopathological records were also excluded.

Methodology

A detailed clinical history was obtained from all patients, including age, parity, menstrual history, menopausal status, presenting complaints, duration of symptoms, abdominal pain, abdominal distension, menstrual irregularities, gastrointestinal or urinary symptoms, and history of weight loss or loss of appetite. General physical examination, abdominal examination, and pelvic examination were performed to assess the size, mobility, tenderness, consistency, and laterality of the adnexal mass.

All patients underwent pelvic ultrasound examination using transabdominal and/or transvaginal ultrasonography, depending on patient suitability and clinical indication. The adnexal masses were evaluated for laterality, size, site, morphology, internal consistency, cystic or solid nature, multilocularity, septations, wall thickness, papillary projections, mural nodules, echogenicity, presence of calcification, hemorrhagic contents, necrotic areas, and ascites. Doppler assessment was performed wherever applicable to evaluate vascularity, blood flow pattern, and resistance index. Ultrasound findings were documented systematically and categorized as suggestive of benign, borderline, or malignant pathology based on morphological and vascular features.

The main parameters assessed included age distribution, parity, menopausal status, presenting symptoms, clinical findings, ultrasound characteristics of the adnexal mass, laterality, tumor size, cystic or solid components, septations, papillary projections, ascites, Doppler vascularity, provisional ultrasound diagnosis, operative findings, and final histopathological diagnosis. Histopathological outcomes were classified into benign, borderline, and malignant lesions. The correlation between ultrasound features and histopathological findings was analyzed.

Patients underwent appropriate surgical management based on clinical condition, ultrasound findings, age, fertility status, and suspected nature of the mass. Surgical specimens were sent for histopathological examination. Gross and microscopic findings were recorded, and the final histopathological diagnosis was considered the gold standard for comparison with ultrasound findings.

The primary outcome was to determine the association between ultrasound features and histopathological diagnosis of adnexal masses. Secondary outcomes included assessment of the distribution of benign and malignant adnexal lesions, identification of ultrasound features suggestive of malignancy, and evaluation of the diagnostic performance of ultrasonography in differentiating benign from malignant adnexal masses.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 27.0. Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as frequency and percentage. The association between ultrasound findings and histopathological outcomes was assessed using the Chi-square test or Fisher's exact test, as appropriate. Sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of ultrasound in detecting malignant adnexal masses were calculated by comparing ultrasound findings with histopathological diagnosis. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1: Demographic Profile and Association with Histopathological Outcome

Table 1 depicts the demographic characteristics of the study population and their association with histopathological outcomes. Among the 95 patients included in the study, the largest proportion belonged to the 31–40 years age group (31.58%), followed by ≤30 years (25.26%), 41–50 years (23.16%), and >50 years (20.00%). Benign lesions were predominantly observed in younger women, with 31.94% of benign cases occurring in patients aged ≤30 years and 37.50% in those aged 31–40 years. In contrast, non-benign lesions were more frequent among older women, particularly those aged >50 years, accounting for 52.17% of all non-benign cases. The association between age and histopathological outcome was statistically significant ($p<0.001$), indicating that advancing age was associated with an increased likelihood of borderline or malignant pathology. With regard to menopausal status, the majority of patients were premenopausal (65.26%), while 14.74% were perimenopausal and 20.00% were postmenopausal. Most benign lesions occurred in premenopausal women (76.39%), whereas non-benign lesions were predominantly observed among postmenopausal women (56.52%). This association was statistically significant ($p<0.001$), suggesting that postmenopausal status is an important risk factor for malignancy in adnexal masses. Regarding parity, 81.05% of patients were multiparous and 18.95% were nulliparous. Although non-benign lesions were slightly more common among multiparous women (86.96%) compared to nulliparous women (13.04%), the difference was not statistically significant ($p=0.407$).

Table 2: Clinical Presentation of Patients with Adnexal Masses

Table 2 summarizes the clinical manifestations observed among patients with adnexal masses. Abdominal pain was the most common presenting complaint, reported by 64.21% of patients. Although

abdominal pain was more frequently observed in benign lesions (69.44%) than in non-benign lesions (47.83%), the association was not statistically significant (p=0.081). Abdominal distension was present in 29.47% of patients and was significantly more common among patients with non-benign lesions (56.52%) than benign lesions (20.83%). The association was statistically significant (p=0.003), suggesting that abdominal distension may be an important clinical indicator of malignant potential. Menstrual irregularities were reported by 25.26% of patients and were more frequently observed in benign lesions (29.17%) than in non-benign lesions (13.04%). However, this difference did not reach statistical significance (p=0.170). Gastrointestinal or urinary symptoms such as bloating, constipation, urinary frequency, or dysuria were present in 18.95% of cases and showed a significant association with non-benign pathology. These symptoms were observed in 43.48% of patients with non-benign lesions compared to only 11.11% of those with benign lesions (p=0.001). Weight loss or loss of appetite was relatively uncommon, occurring in only 7.37% of patients. Nevertheless, it was significantly associated with non-benign lesions, being present in 26.09% of non-benign cases compared with only 1.39% of benign cases (p<0.001). Asymptomatic or incidentally detected masses accounted for 12.63% of cases and were predominantly benign in nature. The difference between benign and non-benign lesions was not statistically significant (p=0.282).

Table 3: Ultrasound Features and Association with Histopathological Outcome

Table 3 evaluates the relationship between various ultrasound characteristics and histopathological findings. Tumor size ≥10 cm was observed in 32.63% of patients and showed a strong association with non-benign lesions. Large tumors were present in 69.57% of non-benign lesions compared to only 20.83% of benign lesions (p<0.001), indicating that increasing tumor size is a significant predictor of malignancy. Bilateral adnexal involvement was noted in 20.00% of patients and was significantly more common in non-benign lesions (47.83%) than benign lesions (11.11%) (p<0.001). Multiloculated lesions were identified in 40.00% of patients and were significantly associated with non-benign pathology (69.57% vs. 30.56%; p=0.001). Solid components within the adnexal mass were observed in 28.42% of cases. This feature demonstrated one of the strongest associations with non-benign lesions, being present in 78.26% of non-benign masses compared to only 12.50% of benign masses (p<0.001). Similarly, thick septations were identified in 30.53% of patients and showed a highly significant association with non-benign pathology (73.91% vs. 16.67%; p<0.001). Papillary projections or mural nodules were seen in 17.89% of cases and were significantly associated with non-benign lesions (60.87% vs. 4.17%; p<0.001). Ascites was present in 13.68% of patients and demonstrated a particularly strong association with non-benign lesions. More than half of the non-benign cases (52.17%) had associated ascites compared with only 1.39% of benign lesions (p<0.001). Doppler evaluation revealed marked vascularity in 27.37% of patients. Increased vascularity was significantly associated with non-benign pathology, occurring in 73.91% of non-benign lesions compared with 12.50% of benign lesions (p<0.001). Likewise, a low resistance index was observed in 20.00% of patients and was significantly more frequent among non-benign lesions (60.87% vs. 6.94%; p<0.001).

Table 4: Histopathological Distribution of Adnexal Masses

Table 4 presents the histopathological spectrum of adnexal masses. Benign lesions constituted the majority of cases, accounting for 75.79% of all patients. Among benign tumors, serous cystadenoma was the most common lesion, observed in 25.26% of cases, followed by mucinous cystadenoma (16.84%), mature cystic teratoma (12.63%), endometriotic cyst (10.53%), hemorrhagic or functional cyst (6.32%), and fibroma/thecoma (4.21%). Borderline tumors represented 5.26% of all cases, including borderline serous tumors (3.16%) and borderline mucinous tumors (2.11%). Although relatively uncommon, these lesions have important clinical implications because of their intermediate malignant potential. Malignant lesions accounted for 18.95% of the study population. Serous cystadenocarcinoma was the most frequently encountered malignancy, comprising 9.47% of all cases and 50.00% of malignant tumors. Other malignant lesions included mucinous cystadenocarcinoma (4.21%), endometrioid carcinoma (3.16%), and malignant germ cell tumors (2.11%).

Table 5: Diagnostic Performance of Ultrasound Compared with Histopathology

Table 5 compares ultrasound diagnosis with the final histopathological findings. Ultrasound classified 69 patients (72.63%) as having benign lesions and 26 patients (27.37%) as having suspicious or non-benign lesions. Histopathological examination confirmed that 66 of the 69 ultrasound-benign lesions were truly benign, while 3 cases were falsely categorized as benign despite having non-benign pathology. Among the 26 lesions classified as suspicious or non-benign on ultrasound, 20 were confirmed as non-benign on histopathology, whereas 6 lesions were ultimately found to be benign. The association between ultrasound findings and histopathological diagnosis was highly significant (p<0.001), demonstrating a strong correlation between preoperative ultrasound assessment and final pathological diagnosis. The diagnostic performance analysis showed that ultrasonography achieved a sensitivity of 86.96% and specificity of 91.67% for detecting non-benign adnexal masses. The positive predictive value was 76.92%, indicating that approximately three-fourths of lesions identified as suspicious on ultrasound were confirmed to be non-benign on histopathology. The negative predictive value was remarkably high at

95.65%, suggesting that lesions classified as benign on ultrasound were very likely to be truly benign. The overall diagnostic accuracy of ultrasonography was 90.53%.

Table 1: Demographic profile and association with histopathological outcome

Variable	Category	Total n (%)	Benign n (%)	Non-benign n (%)	p value
Age group	≤30 years	24 (25.26)	23 (31.94)	1 (4.35)	<0.001
	31–40 years	30 (31.58)	27 (37.50)	3 (13.04)	
	41–50 years	22 (23.16)	15 (20.83)	7 (30.43)	
	>50 years	19 (20.00)	7 (9.72)	12 (52.17)	
Menopausal status	Premenopausal	62 (65.26)	55 (76.39)	7 (30.43)	<0.001
	Perimenopausal	14 (14.74)	11 (15.28)	3 (13.04)	
	Postmenopausal	19 (20.00)	6 (8.33)	13 (56.52)	
Parity	Nulliparous	18 (18.95)	15 (20.83)	3 (13.04)	0.407
	Multiparous	77 (81.05)	57 (79.17)	20 (86.96)	

Table 2: Clinical presentation of patients with adnexal masses

Clinical feature	Total n (%)	Benign n (%)	Non-benign n (%)	p value
Abdominal pain	61 (64.21)	50 (69.44)	11 (47.83)	0.081
Abdominal distension	28 (29.47)	15 (20.83)	13 (56.52)	0.003
Menstrual irregularity	24 (25.26)	21 (29.17)	3 (13.04)	0.170
Gastrointestinal/urinary symptoms	18 (18.95)	8 (11.11)	10 (43.48)	0.001
Weight loss/loss of appetite	7 (7.37)	1 (1.39)	6 (26.09)	<0.001
Asymptomatic/incidental finding	12 (12.63)	11 (15.28)	1 (4.35)	0.282

Table 3: Ultrasound features and association with histopathological outcome

Ultrasound feature	Total n (%)	Benign n (%)	Non-benign n (%)	p value
Tumor size ≥10 cm	31 (32.63)	15 (20.83)	16 (69.57)	<0.001
Bilateral adnexal mass	19 (20.00)	8 (11.11)	11 (47.83)	<0.001
Multiloculated lesion	38 (40.00)	22 (30.56)	16 (69.57)	0.001
Solid component	27 (28.42)	9 (12.50)	18 (78.26)	<0.001
Thick septations	29 (30.53)	12 (16.67)	17 (73.91)	<0.001
Papillary projection/mural nodule	17 (17.89)	3 (4.17)	14 (60.87)	<0.001
Ascites	13 (13.68)	1 (1.39)	12 (52.17)	<0.001
Marked Doppler vascularity	26 (27.37)	9 (12.50)	17 (73.91)	<0.001
Low resistance index	19 (20.00)	5 (6.94)	14 (60.87)	<0.001

Table 4: Histopathological distribution of adnexal masses

Histopathological diagnosis	Number	Percentage (%)
Benign lesions	**72**	**75.79**
Serous cystadenoma	24	25.26
Mucinous cystadenoma	16	16.84
Mature cystic teratoma	12	12.63
Endometriotic cyst	10	10.53
Hemorrhagic/functional cyst	6	6.32
Fibroma/thecoma	4	4.21
Borderline lesions	**5**	**5.26**
Borderline serous tumor	3	3.16
Borderline mucinous tumor	2	2.11
Malignant lesions	**18**	**18.95**
Serous cystadenocarcinoma	9	9.47
Mucinous cystadenocarcinoma	4	4.21
Endometrioid carcinoma	3	3.16
Germ cell tumor	2	2.11
Total	**95**	**100.00**

Table 5: Diagnostic performance of ultrasound compared with histopathology

Ultrasound impression	Histopathology benign n (%)	Histopathology non-benign n (%)	Total n (%)
Benign on ultrasound	66 (69.47)	3 (3.16)	69 (72.63)
Suspicious/non-benign on ultrasound	6 (6.32)	20 (21.05)	26 (27.37)
Total	**72 (75.79)**	**23 (24.21)**	**95 (100.00)**

DISCUSSION

In the present study, benign adnexal lesions were the commonest histopathological outcome, accounting for 72/95 cases (75.79%), while borderline lesions were seen in 5/95 cases (5.26%) and malignant lesions in 18/95 cases (18.95%). When borderline and malignant lesions were grouped together, non-benign lesions constituted 23/95 cases (24.21%). This pattern is comparable with Rai et al. (2019), who studied 127 patients and reported that adnexal masses of ovarian origin were most common, comprising 102 cases (80.30%), of which 12.70% were malignant. In both studies, benign lesions formed the

majority, but the malignant proportion in the present study was slightly higher than that reported by Rai et al., possibly because the present study included only surgically managed masses with histopathological confirmation.[7]

Age and menopausal status showed a significant association with histopathological outcome in the present study. Non-benign lesions were most frequent in women aged >50 years, accounting for 12/23 cases (52.17%), while benign lesions were more common in younger women, especially in the 31–40 years age group. Postmenopausal women also showed a higher proportion of non-benign lesions, with 13/23 cases (56.52%) occurring in this group, and the association was statistically significant ($p<0.001$). Similar observations were reported by Khandelwal et al. (2021), who found that among 18 malignant cases, 10 cases (55.55%) occurred in women aged >50 years and 10 cases (55.55%) occurred in postmenopausal women. Thus, both studies support that increasing age and postmenopausal status are important predictors of malignancy in adnexal masses.[8] In the present study, abdominal pain was the most common presenting complaint, seen in 61/95 patients (64.21%). It was more frequent in benign lesions, occurring in 50/72 cases (69.44%), compared with 11/23 non-benign cases (47.83%), but the association was not statistically significant ($p=0.081$). This finding is similar to Manivasakan et al. (2012), who reported abdominal pain in 70.50% of patients with benign adnexal masses. The similarity indicates that abdominal pain is a frequent presenting symptom in adnexal masses but is not specific for malignancy. In the present study, menstrual irregularity was observed in 24/95 cases (25.26%), while Manivasakan et al. reported that benign adnexal lesions commonly presented with pain rather than specific menstrual complaints, supporting the nonspecific clinical nature of these lesions.[9] Symptoms suggestive of pressure effects and systemic illness were more strongly associated with non-benign lesions in the present study. Abdominal distension was present in 28/95 cases (29.47%) and was significantly higher among non-benign lesions than benign lesions (56.52% vs. 20.83%; $p=0.003$). Gastrointestinal or urinary symptoms were present in 18/95 cases (18.95%) and were significantly associated with non-benign pathology (43.48% vs. 11.11%; $p=0.001$). Weight loss or loss of appetite was seen in only 7/95 cases (7.37%), but it was much more frequent among non-benign lesions (26.09% vs. 1.39%; $p<0.001$). Wasim et al. (2009) also found that gastrointestinal symptoms were significantly more common in malignant ovarian tumors ($p=0.004$), and constitutional symptoms such as loss of appetite and weight loss were present only in malignant tumors ($p=0.001$). Therefore, the present study is consistent with earlier evidence that nonspecific gastrointestinal, urinary, and constitutional symptoms should raise suspicion of malignancy.[10]

Ultrasound morphology showed a strong correlation with histopathological outcome in the present study. Tumor size ≥10 cm was seen in 31/95 cases (32.63%) and was significantly more common in non-benign lesions (69.57% vs. 20.83%; $p<0.001$). Similarly, solid component was present in 78.26% of non-benign lesions compared with 12.50% of benign lesions, thick septations in 73.91% versus 16.67%, papillary projections or mural nodules in 60.87% versus 4.17%, and ascites in 52.17% versus 1.39%, all showing statistically significant associations with non-benign outcome ($p<0.001$). Radhamani et al. (2017) also assessed sonographic features such as size, laterality, locularity, solid elements, ascites, vascularity, resistance index, and pulsatility index, and reported that all malignant tumors showed neovascularization, while resistance index <0.4 was present in 87.50% of malignant tumors. Thus, both studies demonstrate that complex morphology and abnormal Doppler vascularity are important ultrasound predictors of malignancy.[11] The histopathological distribution in the present study showed that serous cystadenoma was the most common benign lesion, accounting for 24/95 cases (25.26%), followed by mucinous cystadenoma in 16/95 cases (16.84%), mature cystic teratoma in 12/95 cases (12.63%), and endometriotic cyst in 10/95 cases (10.53%). Among malignant lesions, serous cystadenocarcinoma was the most common, seen in 9/95 cases (9.47%), representing 50.00% of all malignant tumors. These findings closely correspond with Shrivastava et al. (2021), who reported serous cystadenoma as the commonest benign ovarian lesion (23.30%), followed by mucinous cystadenoma (16.70%), while serous cystadenocarcinoma was the commonest malignant tumor (8.30%). This similarity supports the predominance of epithelial ovarian tumors among adnexal masses in tertiary care hospital settings.[12] In the present study, ultrasound diagnosis showed good diagnostic performance when compared with histopathology. Ultrasound correctly identified 66 benign lesions and 20 non-benign lesions, with 3 false-negative and 6 false-positive cases. The sensitivity was 86.96%, specificity was 91.67%, positive predictive value was 76.92%, negative predictive value was 95.65%, and overall diagnostic accuracy was 90.53% for detecting non-benign adnexal masses. Timmerman et al. (2010), in the IOTA prospective validation study of 1,938 patients, reported 1,396 benign tumors (72.00%), 373 primary invasive tumors (19.20%), 111 borderline tumors (5.70%), and 58 metastatic tumors (3.00%). Their simple ultrasound rules gave conclusive results in 1,501 masses (77.00%) with sensitivity of 92.00% and specificity of 96.00%. The diagnostic indices in the present study are slightly lower but broadly comparable, supporting ultrasound as a reliable first-line modality for preoperative assessment.[13] The high negative predictive value of ultrasound in the present study (95.65%) indicates that lesions interpreted as benign on ultrasound were very likely

to be benign on histopathology. This is clinically important because accurate benign prediction helps avoid unnecessary aggressive surgery, particularly in younger women. Shetty et al. (2019), in a South Indian study of 205 women undergoing surgery for adnexal masses, reported that IOTA simple rules were applicable in 183 tumors (89.30%), with sensitivity of 92.80% and specificity of 92.90%; among the study tumors, 144 were benign and 39 were malignant. The present study showed a similar specificity of 91.67%, although sensitivity was slightly lower at 86.96%, which may be due to differences in sample size, operator experience, and criteria used for categorizing suspicious ultrasound features.[14] Overall, the findings of the present study confirm that combining clinical profile with ultrasound morphology improves preoperative risk stratification of adnexal masses. In this study, older age, postmenopausal status, abdominal distension, gastrointestinal or urinary symptoms, weight loss or loss of appetite, large tumor size, bilaterality, multilocularity, solid components, thick septations, papillary projections, ascites, marked vascularity, and low resistance index were associated with non-benign histopathology. Van Calster et al. (2014), in the development and validation of the ADNEX model, used 3,506 patients for model development, 2,403 for temporal validation, and 5,909 in the updated model, incorporating predictors such as age, CA-125, maximum lesion diameter, solid tissue proportion, more than 10 locules, papillary projections, acoustic shadows, and ascites. The model achieved an AUC of 0.94 for differentiating benign from malignant tumors. The present study's significant ultrasound predictors are therefore consistent with established international models and reinforce the value of structured ultrasound assessment in adnexal masses.[15]

CONCLUSION

Ultrasonography was found to be a useful and reliable modality for preoperative evaluation of adnexal masses. In this study, most lesions were benign, while non-benign lesions were significantly associated with older age, postmenopausal status, abdominal distension, gastrointestinal or urinary symptoms, constitutional symptoms, and suspicious ultrasound features. Large size, bilaterality, multilocularity, solid areas, thick septations, papillary projections, ascites, marked vascularity, and low resistance index showed strong correlation with non-benign histopathology. Ultrasound demonstrated good diagnostic performance and can help in early risk stratification, appropriate surgical planning, and timely referral of suspected malignant cases.

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