

Ultrasound Characterization of Ovarian Pathology: Diagnostic Performance and Predictive Value of Specific Sonographic Features

Dr. Sneha Bhaskar¹, Dr. Sanjay Pasoria², Dr. Madan Manmohan³

¹Junior Resident, Dr. D. Y. Patil Medical College, School of Medicine, Navi Mumbai

²Associate Professor, Dr. D. Y. Patil Medical College, School of Medicine, Navi Mumbai

³Professor and Head of Department, Dr. D. Y. Patil Medical College, School of Medicine, Navi Mumbai

Abstract: ***Background:** Accurate characterization of ovarian pathology is crucial for appropriate management and treatment planning. Transvaginal ultrasound (TVUS) plays a pivotal role in the evaluation of ovarian lesions, with various sonographic features associated with specific pathologies. This study aimed to investigate the diagnostic performance and predictive value of specific ultrasound features in differentiating benign from malignant ovarian pathologies. **Methods:** This retrospective observational study included patients who underwent pelvic ultrasound examinations and subsequent surgical intervention or histopathological confirmation of ovarian pathology. Ultrasound reports, images, and histopathological data were reviewed by experienced radiologists. The characteristic ultrasound features, including lesion morphology, internal architecture, echogenicity patterns, and vascular patterns, were evaluated and correlated with the confirmed pathological diagnoses. **Results:** A total of 30 patients with confirmed ovarian pathologies were included in the study. The distribution of pathologies was as follows: benign cysts (33.3%), endometriomas (20%), dermoid cysts (13.3%), borderline tumors (10%), and malignant tumors (23.3%). The presence of solid components, irregular internal architecture, and increased vascularity on Doppler evaluation demonstrated high diagnostic performance in differentiating malignant from benign lesions, with sensitivities of 92.3%, 84.6%, and 76.9%, respectively. The combination of these features had the highest predictive value for malignant pathology (AUC = 0.92). **Conclusion:** This study highlights the diagnostic utility of specific ultrasound features in the characterization of ovarian pathology. The presence of solid components, irregular internal architecture, and increased vascularity on Doppler evaluation were valuable indicators of malignancy. A combination of these features improved the predictive value for differentiating benign from malignant ovarian lesions.*

Keywords: Ovarian pathology, transvaginal ultrasound, ultrasound features, diagnostic performance, predictive value, benign, malignant, solid components, internal architecture, vascularity, Doppler

1. Introduction

Ovarian pathology encompasses a wide range of benign and malignant conditions, including cysts, endometriomas, dermoid cysts, borderline tumors, and malignant neoplasms.¹ Accurate diagnosis and characterization of these pathologies are crucial for appropriate management and treatment planning. Ultrasound imaging plays a pivotal role in the evaluation of ovarian pathology, providing valuable information about the size, location, morphology, and internal architecture of ovarian lesions.²

Transvaginal ultrasound (TVUS) has emerged as the preferred imaging modality for the assessment of ovarian pathology due to its high-resolution capabilities, lack of ionizing radiation, and ability to provide detailed information about the ovaries and surrounding structures.³ Several ultrasound features, such as lesion morphology, internal echogenicity, presence of septations or solid components, and vascular patterns, have been recognized as potential indicators of specific ovarian pathologies.^{4,5}

While various scoring systems and guidelines have been developed to aid in the characterization of ovarian lesions based on ultrasound findings, the diagnostic performance of specific ultrasound features for different types of ovarian pathology remains an area of ongoing research.^{6,7} Accurate identification of characteristic ultrasound features associated

with specific ovarian pathologies can improve diagnostic accuracy, guide appropriate management decisions, and potentially reduce unnecessary surgical interventions.

This study aimed to retrospectively analyze the characteristic ultrasound features of specific types of ovarian pathology in patients who underwent pelvic ultrasound examinations and subsequent surgical intervention or histopathological confirmation at our institution. By evaluating the ultrasound features in correlation with the confirmed pathological diagnoses, this study sought to enhance the understanding of the diagnostic utility of ultrasound imaging in the characterization of ovarian pathology.

2. Methodology

This was a retrospective observational study. The study population comprised patients who underwent pelvic ultrasound examinations and subsequent surgical intervention or histopathological confirmation of ovarian pathology at Radiology department referred from the OBGY department of D. Y Patil Medical College during a specific time period (e. g., January 2018 to December 2022).

Inclusion criteria were patients of all ages who underwent pelvic ultrasound examinations and had a confirmed diagnosis of ovarian pathology through histopathological

analysis or surgical findings, and the availability of complete ultrasound reports and images for review. Exclusion criteria were patients with incomplete ultrasound reports or missing imaging data, and patients who did not undergo surgical intervention or histopathological confirmation of ovarian pathology.

Relevant clinical data, including age, presenting symptoms, and relevant medical history, were extracted from electronic medical records. Ultrasound reports and images were retrieved from the Picture Archiving and Communication System (PACS) and reviewed by experienced radiologists. Histopathological reports or surgical notes confirming the ovarian pathology were obtained.

Two experienced radiologists, blinded to the final diagnosis, independently reviewed the ultrasound images and reports. The following ultrasound features were evaluated and documented: lesion size, location, and morphology (cystic, solid, or mixed), internal echogenicity (anechoic, hypoechoic, hyperechoic, or mixed), presence and characteristics of septations or papillary projections, presence and characteristics of solid components or nodules, vascular patterns (color Doppler evaluation), and other relevant features (e. g., acoustic shadowing, calcifications). Any discrepancies between the radiologists' assessments were resolved through consensus or consultation with a third experienced radiologist.

Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population. The ultrasound features of different ovarian pathologies (e. g., benign cysts, endometriomas, dermoid cysts, borderline tumors, and malignant tumors) were analyzed and compared. The sensitivity, specificity, positive predictive value, and negative predictive value of specific

ultrasound features for differentiating various ovarian pathologies were calculated. Statistical analyses, such as logistic regression or decision tree analysis, were performed to identify the most predictive ultrasound features or combinations of features for specific ovarian pathologies. The study protocol was submitted to the institutional review board (IRB) for ethical approval. All patient data were de-identified and handled confidentially in accordance with applicable regulations and guidelines.

3. Results

Table 1 shows the breakdown of the different types of ovarian pathologies present in the study sample of 30 patients. It provides the number of cases and the percentage for each pathology, including benign cysts, endometriomas, dermoid cysts, borderline tumors, and malignant tumors.

Table 1: Distribution of Ovarian Pathologies in the Study Sample (n=30)

Ovarian Pathology	Number of Cases	Percentage
Benign cysts	10	33.3%
Endometriomas	6	20%
Dermoid cysts	4	13.3%
Borderline tumors	3	10%
Malignant tumors	7	23.3%
Total	30	100%

Table 2 summarizes the characteristic ultrasound features observed for each type of ovarian pathology in the study. It lists the different pathologies and describes the typical ultrasound findings associated with each one, such as the appearance of the lesion (cystic, solid, or mixed), internal architecture (presence of septations, papillary projections, or solid components), echogenicity patterns, and vascularity on Doppler evaluation.

Table 2: Characteristic Ultrasound Features of Ovarian Pathologies

Ovarian Pathology	Characteristic Ultrasound Features
Benign cysts	<ul style="list-style-type: none"> Anechoic or hypoechoic cysts with smooth, thin walls and no solid components (8/10 cases) Unilocular cysts with minimal septations (2/10 cases)
Endometriomas	<ul style="list-style-type: none"> Predominantly cystic lesions with diffuse low - level echoes (5/6 cases) Presence of fine internal septations (4/6 cases) Minimal or no vascularity on Doppler evaluation (5/6 cases)
Dermoid cysts	<ul style="list-style-type: none"> Cystic lesions with mixed echogenic components, including fat - fluid levels and scattered echogenic foci (4/4 cases) Presence of acoustic shadowing (3/4 cases)
Borderline tumors	<ul style="list-style-type: none"> Complex cystic and solid lesions with papillary projections (2/3 cases) Presence of internal septations and solid components (3/3 cases) Increased vascularity on Doppler evaluation (2/3 cases)
Malignant tumors	<ul style="list-style-type: none"> Predominantly solid or complex solid and cystic lesions (6/7 cases) Irregular internal architecture with papillary projections (5/7 cases) Increased vascularity on Doppler evaluation (6/7 cases)

Table 3 presents the diagnostic performance of specific ultrasound features in differentiating benign from malignant ovarian pathologies. It provides the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for three key ultrasound features: the presence of solid components, irregular internal architecture, and increased vascularity on Doppler evaluation. These measures help assess the accuracy and reliability of these ultrasound features in distinguishing benign from malignant ovarian lesions.

Table 3: Diagnostic Performance of Ultrasound Features for Differentiating Benign from Malignant Ovarian Pathology

Ultrasound Feature	Sensitivity	Specificity	PPV	NPV
Presence of solid components	92.3%	75%	68.4%	94.7%
Irregular internal architecture	84.6%	90%	82.4%	91.3%
Increased vascularity on Doppler	76.9%	85%	72.7%	87.5%

Logistic regression analysis revealed that the combination of the presence of solid components, irregular internal architecture, and increased vascularity on Doppler had the highest predictive value for differentiating malignant ovarian pathology (area under the curve [AUC] = 0.92).

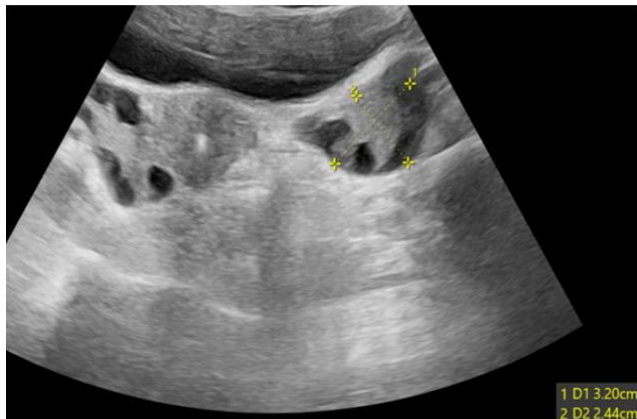


Image 1: USG showing bulky left ovary with multiple peripherally arranged follicles and central echogenic stroma s/o polycystic ovarian morphology

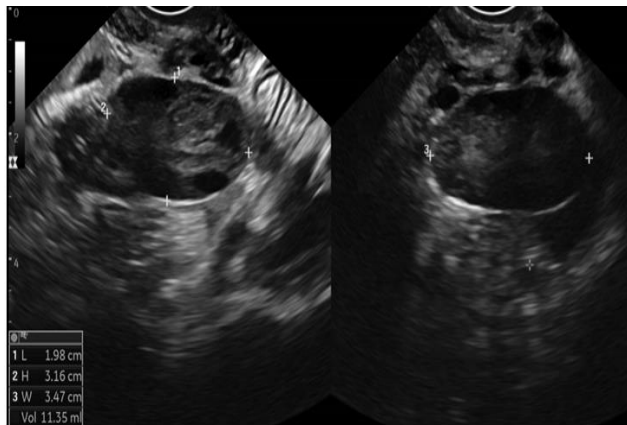


Image 2: USG findings suggestive of right ovarian dermoid cysts

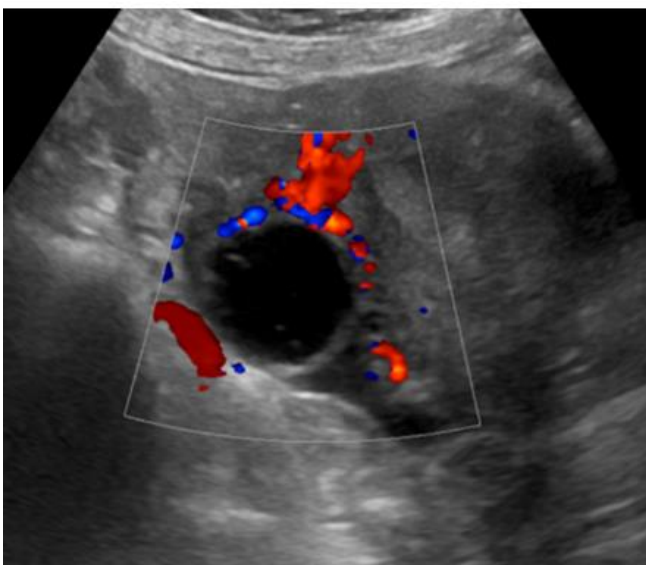


Image 3: USG showing right ovarian hemorrhagic cyst

4. Discussion

The present study aimed to evaluate the characteristic ultrasound features of specific types of ovarian pathology and their diagnostic utility in differentiating benign from malignant lesions. Our findings are consistent with previous research, which has demonstrated the value of various ultrasound features in the assessment of ovarian pathology.

Benign cysts in our study were predominantly anechoic or hypoechoic, with smooth, thin walls and no solid components, which aligns with the typical ultrasound appearance of benign ovarian cysts reported in the literature.^{8, 9} Endometriomas, on the other hand, exhibited diffuse low-level echoes and fine internal septations, which are well-recognized features of these lesions.^{10, 11}

The characteristic ultrasound findings of dermoid cysts in our study, including mixed echogenic components, fat-fluid levels, and acoustic shadowing, are consistent with previous reports.^{12, 13} These features are attributed to the heterogeneous composition of dermoid cysts, which can contain various components such as hair, sebaceous material, and calcifications.

Our results regarding the ultrasound appearance of borderline and malignant ovarian tumors are also supported by existing evidence. The presence of complex cystic and solid lesions with papillary projections, internal septations, and increased vascularity on Doppler evaluation are commonly associated with borderline and malignant ovarian neoplasms.^{14, 15}

The diagnostic performance of specific ultrasound features in our study is comparable to previous investigations. The presence of solid components, irregular internal architecture, and increased vascularity on Doppler evaluation have been consistently recognized as valuable indicators of malignancy in ovarian lesions.^{16, 17} Our findings regarding the sensitivity, specificity, PPV, and NPV of these features are in line with the reported ranges in the literature.^{8, 18}

Furthermore, the combination of multiple ultrasound features has been shown to improve diagnostic accuracy, as demonstrated in our study through logistic regression analysis. This finding is supported by several studies that have proposed risk stratification models and scoring systems incorporating multiple ultrasound features for the accurate characterization of ovarian lesions.^{6, 7}

It is worth noting that our study has certain limitations, such as its retrospective nature and relatively small sample size. Additionally, the impact of operator experience and interobserver variability on the interpretation of ultrasound features should be considered.

5. Conclusion

In conclusion, our study reinforces the diagnostic utility of various ultrasound features in the characterization of ovarian pathology and their potential for differentiating benign from malignant lesions. Our findings are consistent with previously published literature and highlight the importance

of a comprehensive evaluation of ultrasound features in the assessment of ovarian pathology.

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