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Original Article

Analysis of the Sonographic Appearance of Ovarian Endometriosis and Deep Infiltrating Endometriosis

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ABSTRACT

Background: Endometriosis is a chronic estrogen-dependent gynecological disorder commonly associated with pelvic pain, dysmenorrhea, dyspareunia, and infertility. Transvaginal ultrasonography is increasingly used as a first-line imaging modality for identifying ovarian endometriomas and deep infiltrating endometriosis. Objective: To analyze the sonographic features of ovarian endometriomas and deep infiltrating endometriosis among reproductive-age women undergoing pelvic evaluation at Shalamar Hospital, Lahore. Methods: This cross-sectional observational study included 42 women aged 18–45 years with symptoms suggestive of endometriosis. Participants underwent clinical assessment and transvaginal ultrasonography using a standardized pelvic scanning protocol. Ovarian morphology, lesion laterality, echogenicity, Doppler flow, deep pelvic compartment involvement, and clinical symptoms were recorded. Descriptive statistics were calculated, and reported associations were assessed using appropriate inferential tests. Results: Isolated ovarian endometrioma was identified in 21 participants (50.0%), isolated deep infiltrating endometriosis in 7 (16.7%), combined ovarian endometrioma and deep infiltrating endometriosis in 10 (23.8%), and no lesion in 4 (9.5%). Among 31 participants with ovarian endometrioma, ground-glass echogenicity was observed in 24 (77.4%) and minimal or peripheral Doppler flow in 25 (80.6%). Among 17 participants with deep infiltrating endometriosis, uterosacral ligament involvement was most frequent (70.6%), and all lesions were hypoechoic. Conclusion: Transvaginal ultrasonography provided clinically useful characterization of ovarian endometriomas and deep infiltrating endometriosis, supporting its role as a first-line imaging tool in symptomatic reproductive-age women. Keywords: Endometriosis; Ovarian Endometrioma; Deep Infiltrating Endometriosis; Transvaginal Ultrasonography; Pelvic Pain; Infertility.

INTRODUCTION

Endometriosis is a chronic estrogen-dependent gynecological disorder characterized by the presence of endometrial-like glands and stroma outside the uterine cavity. It affects a substantial proportion of women of reproductive age and is commonly associated with chronic pelvic pain, dysmenorrhea, dyspareunia, infertility, and impaired quality of life (1,2). Although the disease burden is clinically significant, diagnosis is frequently delayed because symptoms are heterogeneous, overlap with other pelvic disorders, and may not reliably reflect the anatomical extent of disease (3). This diagnostic delay can contribute to persistent pain, repeated clinical consultations, progression of pelvic adhesions, reproductive difficulty, and delayed initiation of appropriate medical or surgical management.

Endometriosis may present as superficial peritoneal disease, ovarian endometriosis, or deep infiltrating endometriosis. Ovarian endometriosis commonly manifests as endometriomas, which are cystic ovarian lesions containing altered blood products and are often referred to clinically as “chocolate cysts” (4,5). Deep infiltrating endometriosis is generally defined as endometriotic tissue extending more than 5 mm

beneath the peritoneal surface and may involve the uterosacral ligaments, rectovaginal septum, rectosigmoid colon, bladder base, vaginal fornices, and other pelvic compartments (6). Compared with superficial disease, deep infiltrating endometriosis is more frequently associated with severe pain symptoms, dyspareunia, bowel or urinary complaints when adjacent organs are involved, distorted pelvic anatomy, and increased complexity of treatment planning.

Accurate preoperative recognition of ovarian endometriomas and deep infiltrating lesions is essential because the type, location, size, and extent of lesions influence clinical counselling, fertility planning, surgical referral, and operative strategy. Laparoscopy with histopathological confirmation has traditionally been regarded as the reference standard for diagnosis; however, reliance on invasive diagnostic procedures may delay care and is not always necessary when imaging findings are characteristic (7). Advances in pelvic imaging have therefore shifted diagnostic pathways toward non-invasive assessment, particularly in women presenting with symptoms suggestive of endometriosis. Among available modalities, transvaginal ultrasonography has become a first-line investigation because it is accessible, relatively inexpensive, repeatable, and capable of providing detailed information about ovarian morphology and deep pelvic compartments when performed systematically (8).

The sonographic appearance of ovarian endometriomas is relatively well established. They usually appear as unilocular or multilocular ovarian cysts with homogeneous low-level internal echoes, classically described as a ground-glass appearance, and typically demonstrate limited internal vascularity on Doppler assessment (9). These features help differentiate endometriomas from functional hemorrhagic cysts, dermoid cysts, and suspicious adnexal masses, although atypical morphology may still require further evaluation. In contrast, deep infiltrating endometriosis has a broader and more location-dependent sonographic spectrum. It may appear as hypoechoic nodules, irregular fibrotic thickening, reduced tissue mobility, adhesions, obliteration of normal sliding between pelvic organs, or distortion of the posterior pelvic compartment (10). A systematic pelvic ultrasound approach can improve detection of deep lesions and support preoperative disease mapping (11).

Despite growing international evidence supporting the role of transvaginal ultrasonography in endometriosis assessment, local data describing the sonographic patterns of ovarian endometriomas and deep infiltrating endometriosis among symptomatic women remain limited. This is clinically relevant because diagnostic confidence depends not only on the presence of characteristic imaging signs but also on their relationship with common clinical presentations such as pelvic pain, dysmenorrhea, dyspareunia, and infertility. A focused evaluation of sonographic morphology in women undergoing pelvic assessment may therefore help strengthen early recognition, guide referral decisions, and improve the practical use of ultrasound as a first-line diagnostic tool in routine gynecological settings.

The present study was designed to analyze the sonographic features of ovarian endometriomas and deep infiltrating endometriosis among women of reproductive age presenting with symptoms suggestive of endometriosis at Shalamar Hospital, Lahore. The study specifically aimed to describe the ultrasound morphology, lesion distribution, Doppler characteristics, and clinical symptom patterns associated with ovarian and deep infiltrating lesions, with the objective of improving diagnostic characterization and supporting timely clinical management in women undergoing pelvic evaluation (12).

MATERIALS AND METHODS

This cross-sectional observational study was conducted at Shalamar Hospital, Lahore, to evaluate the sonographic appearance of ovarian endometriomas and deep infiltrating endometriosis among women undergoing pelvic assessment for symptoms suggestive of endometriosis. The study was carried out over a four-month period after approval of the research synopsis and institutional ethical clearance. A cross-sectional design was selected because the primary objective was to describe lesion morphology, distribution, and associated clinical features at the time of ultrasound evaluation rather than to determine disease progression or treatment response.

The study population consisted of women of reproductive age, 18–45 years, who presented with clinical features suggestive of endometriosis, including dysmenorrhea, dyspareunia, chronic pelvic pain, and subfertility or infertility. Participants were recruited through a non-probability consecutive sampling technique, and eligible women were enrolled in sequence until the required sample size was achieved. Women were included if they were clinically suspected of having endometriosis, were referred for transvaginal ultrasonography, provided written informed consent, and had adequate visualization of the ovaries and relevant pelvic compartments during ultrasound examination. Postmenopausal women, pregnant women, patients with known pelvic malignancy, women with a history of major pelvic surgery causing substantial alteration of pelvic anatomy, and those unwilling to undergo transvaginal ultrasonography were excluded.

The minimum sample size was estimated as 42 participants using Cochran's formula, with an expected prevalence of 2.6%, a 95% confidence level, and a 5% margin of error. Eligible participants were recruited after explanation of the study purpose, ultrasound procedure, potential discomfort, confidentiality safeguards, and voluntary nature of participation. Written informed consent was obtained before clinical information was recorded or imaging was performed. Participant identities were anonymized during data entry and analysis to protect confidentiality.

Data were collected using a structured data collection form. Demographic and clinical variables included age, reproductive history, infertility status, menstrual history, pelvic pain, dysmenorrhea, dyspareunia, previous pelvic surgery, and relevant medication history. Pelvic pain, dysmenorrhea, dyspareunia, and infertility were recorded as clinical presentation variables. Sonographic variables for ovarian endometriomas included lesion presence, laterality, number of cysts, cyst size, echogenicity, wall characteristics, septations, and Doppler vascularity. Ovarian endometrioma was operationally identified on ultrasound as an ovarian cystic lesion showing features compatible with endometrioma, particularly homogeneous low-level internal echoes or ground-glass echogenicity with absent, minimal, or peripheral Doppler flow. Deep infiltrating endometriosis was assessed by evaluating the uterosacral ligaments, rectovaginal septum, rectosigmoid region, bladder base, anterior compartment, and vaginal fornices. Sonographic features suggestive of deep infiltrating endometriosis included hypoechoic nodular lesions, irregular tissue thickening, compartmental distortion, restricted mobility, and low or peripheral Doppler vascularity.

Ultrasound examinations were performed using a high-resolution ultrasound system available at Shalamar Hospital. A 5–9 MHz transvaginal probe was used for detailed assessment of ovarian morphology and deep pelvic structures, while a 3.5–5 MHz convex transabdominal probe was used when additional abdominal or pelvic overview was required. All scans were performed according to a standardized pelvic scanning protocol by an experienced sonologist. The examination first assessed the uterus, adnexa, and ovarian morphology, followed by targeted evaluation of suspected endometriotic lesions and deep pelvic compartments. Color Doppler and Power Doppler were used to evaluate vascularity when lesions were identified. Representative ultrasound images and relevant measurements were recorded for each participant and entered into the structured proforma.

To reduce selection and measurement bias, participants were recruited consecutively according to predefined eligibility criteria, ultrasound examinations followed a standardized scanning sequence, and lesion characteristics were documented using the same structured data form. Adequate visualization of ovarian and deep pelvic structures was required for inclusion to reduce misclassification caused by technically limited scans. Data were checked for completeness and internal consistency before analysis. Variables with incomplete documentation were handled according to available-case analysis for the relevant descriptive or inferential procedure, while the denominator for each analysis was reported according to the number of participants or lesions with available data.

Data were entered and analyzed using Statistical Package for Social Sciences version 24.0. Descriptive statistics were calculated for demographic, clinical, and sonographic variables. Categorical variables

were summarized as frequencies and percentages, while continuous variables such as cyst size and nodule size were summarized as mean and standard deviation where distributional assumptions were acceptable. Associations between categorical clinical variables and lesion type were assessed using the chi-square test or Fisher's exact test where expected cell counts were small. Correlation analysis was planned for continuous or ordinal variables, including lesion size and symptom severity, only when the measurement scale and distribution were appropriate. For participants with laparoscopic verification, diagnostic performance of transvaginal ultrasonography was assessed using two-by-two contingency tables for each lesion type. Sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic odds ratio with 95% confidence intervals were calculated where sufficient true-positive, false-positive, true-negative, and false-negative counts were available. A p-value of less than 0.05 was considered statistically significant.

Ethical approval was obtained from the Institutional Review Board of Superior University before data collection. All participants were informed about the study objectives, examination procedure, voluntary participation, right to withdraw, and confidentiality of collected information. Written informed consent was obtained from each participant before enrolment. Data were anonymized, stored securely, and used only for research analysis. The study was conducted in accordance with standard ethical principles for human participant research and did not involve any therapeutic intervention beyond clinically indicated pelvic ultrasound assessment.

RESULTS

A total of 42 women of reproductive age were included in the analysis. The largest proportion of participants belonged to the 26–35-year age group, while pelvic pain and dysmenorrhea were the most frequently reported clinical symptoms. Infertility was reported by more than half of the participants, and dyspareunia was present in fewer than half of the study population.

Table 1. Demographic and Clinical Characteristics of Participants (n = 42)

Variable	Category	n	%
Age group	18–25 years	5	12.0
	26–35 years	29	69.0
	36–45 years	8	19.0
Infertility	Yes	26	61.9
	No	16	38.1
Pelvic pain	Yes	34	81.0
	No	8	19.0
Dysmenorrhea	Yes	32	76.2
	No	10	23.8
Dyspareunia	Yes	18	42.8
	No	24	57.2

Most participants were aged 26–35 years, accounting for 29 of 42 women. Pelvic pain was reported by 34 participants, followed by dysmenorrhea in 32 participants, infertility in 26 participants, and dyspareunia in 18 participants. These findings indicate that the study population predominantly consisted of symptomatic reproductive-age women undergoing pelvic evaluation for clinical features suggestive of endometriosis.

The distribution of lesion patterns showed that ovarian endometrioma alone was the most common finding, followed by combined ovarian endometrioma with deep infiltrating endometriosis. Isolated deep infiltrating endometriosis was less frequent, while a small proportion of participants had no ovarian endometrioma or deep infiltrating lesion detected on transvaginal ultrasonography.

Ovarian endometrioma was present either alone or in combination with deep infiltrating endometriosis in 31 participants, while deep infiltrating endometriosis was present either alone or in combination with ovarian endometrioma in 17 participants. The separation of isolated and combined lesion patterns

clarifies the overlap between ovarian and deep infiltrating disease and provides consistent denominators for subsequent sonographic characterization.

Table 2. Distribution of Sonographic Lesion Patterns Among Participants (n = 42)

Lesion Pattern	n	%
Isolated ovarian endometrioma	21	50.0
Isolated deep infiltrating endometriosis	7	16.7
Combined ovarian endometrioma and deep infiltrating endometriosis	10	23.8
No ovarian endometrioma or deep infiltrating endometriosis detected	4	9.5

Among the 31 participants with ovarian endometrioma, right-sided lesions were most frequent, followed by left-sided and bilateral lesions. Most endometriomas were single cysts and demonstrated homogeneous ground-glass echogenicity with minimal or peripheral Doppler flow.

Table 3. Sonographic Characteristics of Ovarian Endometriomas (n = 31)

Parameter	Category	n	%
Laterality	Right ovary	14	45.2
	Left ovary	10	32.3
	Bilateral	7	22.5
Number of cysts	Single	21	67.7
	Multiple	10	32.3
Echogenicity	Ground-glass	24	77.4
	Heterogeneous	7	22.6
Doppler flow	Minimal/peripheral	25	80.6
	Moderate internal flow	6	19.4
Mean cyst size	cm	4.5 ± 1.9	—

The most common ovarian endometrioma pattern was a single right-sided cyst with ground-glass echogenicity and minimal or peripheral Doppler flow. Ground-glass echogenicity was observed in 24 of 31 participants with ovarian endometrioma, and minimal or peripheral flow was recorded in 25 participants. The mean cyst size was 4.5 ± 1.9 cm, supporting the predominance of morphologically typical endometriomas in this cohort.

Among the 17 participants with deep infiltrating endometriosis, the uterosacral ligaments were the most frequently involved site, followed by the rectovaginal septum. All deep infiltrating lesions were described as hypoechoic, and most participants had nodular lesions.

Table 4. Sonographic Characteristics of Deep Infiltrating Endometriosis (n = 17)

Parameter	Category	n	%
Uterosacral ligament involvement	Present	12	70.6
Rectovaginal septum involvement	Present	8	47.1
Rectosigmoid colon involvement	Present	4	23.5
Bladder/anterior compartment involvement	Present	3	17.6
Nodules present	Yes	14	82.3
	No	3	17.7
Echogenicity	Hypoechoic	17	100.0
Doppler flow	Peripheral	10	58.8
	Minimal	7	41.2
Mean nodule size	cm	1.9 ± 0.8	—

Deep infiltrating endometriosis most frequently involved the posterior pelvic compartment. Uterosacral ligament involvement was present in 12 of 17 participants, while rectovaginal septum involvement was present in 8 participants. Nodular lesions were observed in 14 participants, and all lesions demonstrated hypoechoic echogenicity. The mean nodule size was 1.9 ± 0.8 cm, with Doppler assessment showing either peripheral or minimal vascularity.

The manuscript reported statistically significant associations between lesion pattern and selected clinical symptoms. Pelvic pain was associated with lesion type, and infertility was associated with deep infiltrating or combined lesion patterns. Complete cross-tabulated counts and effect estimates were not available in the supplied data.

Table 5. Reported Symptom–Lesion Associations

Association	Statistical Test	p-value
Pelvic pain and lesion type	Chi-square test	0.02
Infertility and deep infiltrating or combined lesion pattern	Chi-square test	0.04

Pelvic pain showed a reported association with lesion type, while infertility showed a reported association with deep infiltrating or combined lesion patterns. Because the underlying cross-tabulated frequencies, effect estimates, and confidence intervals were not available, these findings should be interpreted as reported associations rather than fully reproducible comparative estimates.

Diagnostic accuracy of transvaginal ultrasonography was reported in a subset of participants who had laparoscopic verification. Transvaginal ultrasonography showed high reported sensitivity, specificity, positive predictive value, and negative predictive value for ovarian endometrioma and deep infiltrating endometriosis.

Table 6. Reported Diagnostic Accuracy of Transvaginal Ultrasonography Compared With Laparoscopic Verification

Lesion Type	Verification Subset	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Diagnostic Odds Ratio	95% CI
Ovarian endometrioma	18	94.4	91.6	92.8	93.3	15.6	4.3–28.2
Deep infiltrating endometriosis	18	88.8	86.1	90.0	84.6	10.2	3.7–19.8

In the laparoscopic verification subset, transvaginal ultrasonography demonstrated reported sensitivity of 94.4% and specificity of 91.6% for ovarian endometrioma, with a positive predictive value of 92.8% and negative predictive value of 93.3%. For deep infiltrating endometriosis, reported sensitivity was 88.8%, specificity was 86.1%, positive predictive value was 90.0%, and negative predictive value was 84.6%. These diagnostic findings support the clinical utility of transvaginal ultrasonography in lesion identification, although the absence of raw two-by-two diagnostic counts limits independent verification of the reported accuracy estimates.

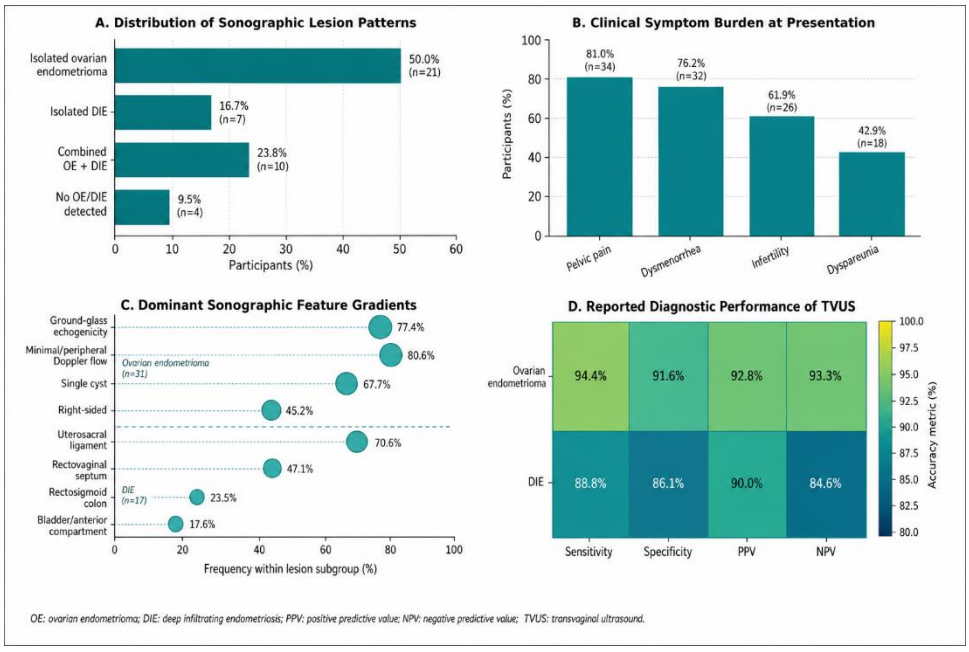

Figure 1. Integrated Clinical and Sonographic Profile of Suspected Endometriosis on Transvaginal Ultrasonography

The panelled figure summarizes the clinical and imaging profile of 42 women undergoing transvaginal ultrasonography for suspected endometriosis. Isolated ovarian endometrioma was the most frequent lesion pattern, observed in 21 participants (50.0%), followed by combined ovarian endometrioma and deep infiltrating endometriosis in 10 participants (23.8%), isolated deep infiltrating endometriosis in 7 participants (16.7%), and no detected ovarian or deep infiltrating lesion in 4 participants (9.5%). Symptom burden was high, with pelvic pain reported by 34 participants (81.0%), dysmenorrhea by 32

(76.2%), infertility by 26 (61.9%), and dyspareunia by 18 (42.8%). Among ovarian endometriomas, the dominant sonographic pattern was ground-glass echogenicity in 24 of 31 cases (77.4%) and minimal or peripheral Doppler flow in 25 of 31 cases (80.6%), while deep infiltrating endometriosis most commonly involved the uterosacral ligaments in 12 of 17 cases (70.6%) and appeared hypoechoic in all 17 cases (100.0%). In the laparoscopic verification subset, transvaginal ultrasonography showed reported sensitivity and specificity of 94.4% and 91.6% for ovarian endometrioma and 88.8% and 86.1% for deep infiltrating endometriosis, respectively, supporting its clinical value as a first-line imaging modality while requiring cautious interpretation due to the limited verification subset.

DISCUSSION

The present study evaluated the sonographic profile of ovarian endometriomas and deep infiltrating endometriosis among 42 reproductive-age women undergoing pelvic assessment for symptoms suggestive of endometriosis. The study population was predominantly composed of women aged 26–35 years, which is consistent with the recognized reproductive-age distribution of endometriosis and supports the clinical relevance of targeted imaging in this age group. Pelvic pain and dysmenorrhea were the most frequent presenting symptoms, reported by 81.0% and 76.2% of participants, respectively, while infertility was present in 61.9% and dyspareunia in 42.8%. This symptom pattern is consistent with the broader literature describing endometriosis as a pain- and fertility-related disorder that often produces overlapping gynecological and reproductive complaints rather than a single pathognomonic clinical presentation (13,14).

The lesion distribution observed in this cohort showed that isolated ovarian endometrioma was the most frequent sonographic pattern, affecting 50.0% of participants, while isolated deep infiltrating endometriosis was identified in 16.7% and combined ovarian endometrioma with deep infiltrating endometriosis in 23.8%. This distribution highlights the importance of evaluating both the ovaries and deep pelvic compartments during transvaginal ultrasonography, because restricting assessment to adnexal morphology alone may fail to identify coexisting deep disease. The presence of combined lesions in nearly one-quarter of the sample further supports a systematic scanning approach in symptomatic women, particularly when infertility, dyspareunia, or severe pelvic pain is reported. Previous studies have similarly emphasized that ovarian and deep endometriotic lesions may coexist and that comprehensive pelvic mapping improves diagnostic confidence and clinical planning (15,16).

The sonographic morphology of ovarian endometriomas in the present study was largely consistent with established ultrasound descriptions. Among 31 participants with ovarian endometrioma, ground-glass echogenicity was observed in 77.4%, minimal or peripheral Doppler flow in 80.6%, and a single cyst pattern in 67.7%. These findings support the diagnostic value of homogeneous low-level internal echoes and limited vascularity as characteristic features of endometriomas. The mean cyst size of 4.5 ± 1.9 cm also falls within a clinically relevant range in which ultrasound characterization is important for differentiating endometrioma from hemorrhagic cysts, dermoid cysts, and other adnexal masses. Prior diagnostic literature has consistently recognized ground-glass echogenicity, low internal vascularity, and typical cyst morphology as important sonographic criteria for ovarian endometrioma assessment (17,18).

Deep infiltrating endometriosis was identified in 17 participants either alone or in combination with ovarian endometrioma. The uterosacral ligaments were the most frequently involved site, present in 70.6% of participants with deep infiltrating disease, followed by rectovaginal septum involvement in 47.1%, rectosigmoid colon involvement in 23.5%, and bladder or anterior compartment involvement in 17.6%. All deep infiltrating lesions were described as hypoechoic, and nodules were present in 82.3%. These findings are compatible with the recognized sonographic appearance of deep infiltrating endometriosis, where hypoechoic nodularity, fibrotic thickening, reduced mobility, and distortion of posterior pelvic anatomy are commonly reported. The predominance of posterior compartment

involvement in this study aligns with previous work showing that the uterosacral ligaments and rectovaginal region are frequent sites of deep disease (19,20).

The reported association between pelvic pain and lesion type, with a p-value of 0.02, suggests that symptom burden may vary according to sonographic disease pattern. Similarly, the reported association between infertility and deep infiltrating or combined lesion patterns, with a p-value of 0.04, is clinically plausible because deep lesions and coexisting ovarian disease may contribute to reproductive dysfunction through inflammatory, anatomical, ovarian reserve, and tubal-peritoneal mechanisms. However, these associations should be interpreted cautiously because the supplied data did not include the full cross-tabulated frequencies, odds ratios, confidence intervals, or adjustment for potential confounders such as age, duration of symptoms, previous surgery, or prior treatment. Future analyses should present complete contingency tables and adjusted estimates to clarify whether these associations remain stable after accounting for clinically relevant covariates (21,22).

The diagnostic accuracy findings suggest that transvaginal ultrasonography performed well in the laparoscopic verification subset, with reported sensitivity and specificity of 94.4% and 91.6% for ovarian endometrioma and 88.8% and 86.1% for deep infiltrating endometriosis, respectively. These findings are directionally consistent with studies showing that transvaginal ultrasonography can provide high diagnostic accuracy for ovarian endometriomas and several forms of deep infiltrating endometriosis when performed by trained operators using systematic scanning protocols. Nevertheless, the diagnostic accuracy results in the present study require cautious interpretation because laparoscopic verification was reported only for a subset of 18 participants, and the manuscript did not provide the underlying true-positive, false-positive, true-negative, and false-negative counts. This incomplete verification may introduce partial verification bias and limits independent reproducibility of the reported sensitivity, specificity, predictive values, and diagnostic odds ratios (23,24).

The findings have practical clinical implications. In symptomatic reproductive-age women, transvaginal ultrasonography can support early identification of typical ovarian endometriomas and raise suspicion for deep infiltrating disease through recognition of hypoechoic nodules, posterior compartment involvement, and low vascularity. The combined assessment of symptom profile and lesion morphology may assist clinicians in selecting patients for gynecological referral, fertility counselling, further imaging, or surgical planning. However, ultrasound findings should not be interpreted in isolation, particularly in cases with atypical morphology, poor visualization, suspected bowel or bladder involvement, or discordance between symptoms and imaging findings. In such cases, further expert imaging, multidisciplinary assessment, or surgical evaluation may be required (25,26).

This study has several limitations that should be considered when interpreting the findings. The sample size was small, and the single-center design with non-probability consecutive sampling limits generalizability. The diagnostic accuracy analysis was based on a limited laparoscopic verification subset, which restricts the strength of conclusions regarding sensitivity and specificity. Ultrasound diagnosis is operator-dependent, and the study did not report interobserver agreement or blinding of the sonologist to clinical symptoms. In addition, the manuscript did not provide complete statistical outputs for symptom-lesion associations or correlations involving lesion size and symptom severity; therefore, these findings should be considered preliminary unless supported by full statistical tables. Despite these limitations, the study provides useful local descriptive evidence on the sonographic appearance of ovarian endometriomas and deep infiltrating endometriosis and supports the role of systematic transvaginal ultrasonography in the initial assessment of women with suspected endometriosis.

CONCLUSION

This study concluded that transvaginal ultrasonography is a useful first-line, non-invasive imaging modality for detecting and characterizing ovarian endometriomas and deep infiltrating endometriosis in symptomatic women of reproductive age. Ovarian endometriomas most commonly demonstrated

ground-glass echogenicity with minimal or peripheral Doppler flow, while deep infiltrating endometriosis was predominantly identified as hypoechoic nodular disease involving the uterosacral ligaments and rectovaginal septum. The separation of isolated ovarian endometrioma, isolated deep infiltrating endometriosis, and combined lesion patterns clarified the distribution of disease and demonstrated the importance of systematic pelvic compartment assessment. Reported associations between lesion pattern, pelvic pain, and infertility suggest clinically relevant symptom-imaging relationships, although these require confirmation through complete cross-tabulated and adjusted analyses. The diagnostic accuracy findings support the clinical utility of transvaginal ultrasonography, but they should be interpreted cautiously because laparoscopic verification was available only in a limited subset.

REFERENCES

1. Czubak P, Herda K, Niewiadomska I, Putowski L, Łańcut M, Masłyk M. Understanding endometriosis: a broad review of its causes, management, and impact. Int J Mol Sci. 2025;26(18):8878.

2. Xu S, Zhang Y, Ye P, Huang Q, Wang Y, Zhang Y, et al. Global, regional, and national burden of endometriosis among women of childbearing age from 1990 to 2021: a cross-sectional analysis from the 2021 Global Burden of Disease Study. Int J Surg. 2025;111(9):5927-40.

3. Alson S, Jokubkiene L, Henic E, Sladkevicius P. Prevalence of endometrioma and deep infiltrating endometriosis at transvaginal ultrasound examination of subfertile women undergoing assisted reproductive treatment. Fertil Steril. 2022;118(5):915-23.

4. Capraş RD, Badea IC, Moldovan M, Gaia-Oltean AI, Badea AF, Telecan T, editors. The diagnostic performance of transvaginal ultrasound for posterior compartment endometriosis compared to laparoscopic and histopathological findings: a systematic review. Healthcare. 2025.

5. Daniilidis A, Grigoriadis G, Dalakoura D, D'Alterio MN, Angioni S, Roman H. Transvaginal ultrasound in the diagnosis and assessment of endometriosis—an overview: how, why, and when. Diagnostics. 2022;12(12):2912.

6. Guerriero S, Ajossa S, Pagliuca M, Borzacchelli A, Deiala F, Springer S, et al. Advances in imaging for assessing pelvic endometriosis. Diagnostics. 2022;12(12):2960.

7. Idle S, Ross J. Meeting of the British Medical Ultrasound Society, 4–6 December 2018, The Point, Emirates Old Trafford, Manchester, UK. Ultrasound. 2019;27(2).

8. Pascoal E, Wessels J, Aas-Eng M, Abrao MS, Condous G, Jurkovic D, et al. Strengths and limitations of diagnostic tools for endometriosis and relevance in diagnostic test accuracy research. Ultrasound Obstet Gynecol. 2022;60(3):309-27.

9. Constantinou CE. Dynamics of female pelvic floor function using urodynamics, ultrasound and magnetic resonance imaging. Eur J Obstet Gynecol Reprod Biol. 2009;144 Suppl 1.

10. Raiza LCP, Bianchi PHM, Piccinato CA, Podgaec S. Sonographic signs of deep infiltrative endometriosis among women submitted to routine transvaginal sonography: clinical and imaging aspects. Einstein (Sao Paulo). 2022;20.

11. Radhika AG, Chawla S, Nanda P, Yadav G, Radhakrishnan G. A multivariate analysis of correlation between severity and duration of symptoms, patient profile and stage of endometriosis. Open J Obstet Gynecol. 2016;6(10):615-22.

12. Raffeld MR. Barriers and facilitators to urogynecologic care: an investigation into patient, provider, and structural factors influencing access and treatment. Philadelphia: Temple University; 2024.

13. Ellis K, Munro D, Clarke J. Endometriosis is undervalued: a call to action. Front Glob Womens Health. 2022;3:902371.

14. Qi Q, Li Y, Chen Z, Luo Z, Zhou T, Zhou J, et al. Update on the pathogenesis of endometriosis-related infertility based on contemporary evidence. Front Endocrinol. 2025;16:1558271.

15. Xu Z, Li Y, Wang Y, Wan Y, Chen J. Transvaginal ultrasound and magnetic resonance imaging in detecting rectosigmoid deep infiltrating endometriosis: a comparative meta-analysis. Front Med. 2025;12:1552185.

16. Ferrero S, Barra F, Perrone U, Paudice M, Vellone VG. Ultrasound diagnosis of bowel endometriosis. Gynecol Obstet Invest. 2025;90(3):268-78.

17. Wu H, Sang X, Zhao S, Chen J, Gu H, Yuan H, et al. Analysis of clinical characteristics, diagnosis, treatment, and postoperative outcomes in deep infiltrating endometriosis: a retrospective study. Eur J Obstet Gynecol Reprod Biol. 2025:114607.

18. Guerriero S, Condous G, Rolla M, Pedrassani M, Leonardi M, Hudelist G, et al. Addendum to consensus opinion from the International Deep Endometriosis Analysis group: sonographic evaluation of superficial endometriosis. Ultrasound Obstet Gynecol. 2025;66(4):541-7.

19. Mick I, Freger SM, Marien M, Gholiof M, Leonardi M. Diagnostic accuracy of transvaginal ultrasonography for endometriosis according to the International Deep Endometriosis Analysis consensus. O&G Open. 2025;2(1).

20. Nagar R, Aharoni S, Leonardi M. Use of intraoperative ultrasound to aid in diagnosis and management of unusual endometrioma. J Endometr Uterine Disord. 2025:100116.

21. Garzon S, Laganà AS, Guerriero S, Alcázar JL, Dababou S, Uccella S, et al. Transvaginal sonography for the preoperative assessment of parametrial deep infiltrating endometriosis: a diagnostic accuracy study. Gynecol Obstet Invest. 2024;89(2):111-9.

22. Mostafavi SRS, Kor E, Sakhaei SM, Kor A. The correlation between ultrasonographic findings and clinical symptoms of pelvic endometriosis. BMC Res Notes. 2024;17(1):108.

23. Bean E, Knez J, Setty T, Tetteh A, Casagrandi D, Naftalin J, et al. Natural history of endometriosis in pregnancy: ultrasound study of morphology of deep endometriosis and ovarian endometrioma. Ultrasound Obstet Gynecol. 2023;62(4):585-93.

24. Chaggar P, Tellum T, Thanatsis N, De Braud L, Setty T, Jurkovic D. Prevalence of deep and ovarian endometriosis in women attending a general gynecology clinic: prospective cohort study. Ultrasound Obstet Gynecol. 2023;61(5):632-41.

25. Ştefan RA, Ştefan PA, Mihu CM, Csutak C, Melincovici CS, Crivii CB, et al. Ultrasonography in the differentiation of endometriomas from hemorrhagic ovarian cysts: the role of texture analysis. J Pers Med. 2021;11(7):611.

26. Alborzi S, Rasekhi A, Shomali Z, Madadi G, Alborzi M, Kazemi M, et al. Diagnostic accuracy of magnetic resonance imaging, transvaginal, and transrectal ultrasonography in deep infiltrating endometriosis. Medicine. 2018;97(8).