TRANSVAGINAL ULTRASONOGRAPHY IN DETECTING ENDOMETRIAL HYPERPLASIA IN POST-MENOPAUSAL WOMEN

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ABSTRACT

OBJECTIVES

This study aimed to determine the diagnostic accuracy of transvaginal ultrasonography in detecting histopathologically confirmed endometrial pathology in post-menopausal women, using histopathological examination as the reference standard.

METHODOLOGY

This descriptive cross-sectional diagnostic accuracy study was conducted at MTI Bacha Khan Medical College and Mardan Medical Complex, Mardan. A total of 93 post-menopausal women were enrolled through consecutive sampling. TVS assessed endometrial thickness and associated ultrasound findings. Histopathological examination of the endometrial sample was used as the reference standard. Data were analyzed using SPSS version 25. Sensitivity, specificity, positive predictive value, negative predictive value, diagnostic accuracy, and 95% confidence intervals were calculated. Receiver operating characteristic curve analysis was performed, and the optimal cutoff was determined using the Youden index.

RESULTS

The mean age of participants was 58.8 ± 8.8 years, and the mean endometrial thickness was 8.45 ± 3.67 mm. Histopathology showed normal endometrium in 31 (33.3%) cases, endometrial hyperplasia in 52 (55.9%), and endometrial carcinoma in 10 (10.8%). Using a predefined cutoff of >10 mm, TVS showed sensitivity of 58.1% (95% CI: 45.7-69.5), specificity of 100.0% (95% CI: 89.0–100.0), positive predictive value of 100.0% (95% CI: 90.4–100.0), negative predictive value of 54.4% (95% CI: 41.6–66.6), and diagnostic accuracy of 72.0% (95% CI: 62.2–80.1). ROC analysis showed an area under the curve of 0.935 (95% CI: 0.887–0.984; $p < 0.001$). The optimal cutoff by the Youden index was ≥5.65 mm, with a sensitivity of 93.5% and a specificity of 77.4%.

CONCLUSION

Transvaginal ultrasonography is a useful initial, non-invasive tool for evaluating endometrial pathology in post-menopausal women. The >10 mm cutoff showed excellent specificity but moderate sensitivity, indicating that it is more useful for ruling in disease than for ruling it out. A lower ROC-derived cutoff may improve screening sensitivity, but histopathological confirmation remains essential for definitive diagnosis.

KEYWORDS: *Transvaginal Ultrasonography, Postmenopausal Bleeding, Diagnostic Accuracy, Histopathology, ROC Curve*

INTRODUCTION

Endometrial hyperplasia is a clinically important gynecological condition characterized by abnormal proliferation of endometrial glands relative to the stroma, resulting in thickening of the endometrial lining. It is considered a precursor lesion for endometrial carcinoma, particularly when cytological atypia is present.[1] The underlying pathophysiology is mainly related to prolonged unopposed estrogen stimulation, which promotes continuous endometrial proliferation without adequate progesterone-mediated secretory transformation. This hormonal imbalance is commonly associated with obesity, diabetes mellitus, hypertension, nulliparity, and exogenous estrogen exposure, all of which increase the risk of endometrial hyperplasia and malignant transformation.[2,3] In post-menopausal women, abnormal uterine bleeding is an important clinical warning sign, and timely evaluation is essential to detect premalignant or malignant endometrial disease at an early stage. Transvaginal ultrasonography (TVS) is widely used as a first-line, non-invasive imaging modality for evaluating endometrial pathology in post-menopausal women.[4] Measurement of endometrial thickness is one of the most commonly used sonographic parameters because it is simple, reproducible, and clinically useful for deciding whether further invasive evaluation is required. However, the diagnostic accuracy

of TVS varies across studies due to differences in patient characteristics, menopausal status, bleeding symptoms, operator expertise, ultrasound technique, and selected endometrial thickness cutoff values. Lower cutoff values generally improve sensitivity and reduce the chances of missing disease, whereas higher cutoff values improve specificity but may fail to detect early or less extensive hyperplastic changes.[5,6] Therefore, selecting an appropriate cutoff remains clinically important, particularly when balancing the need to avoid unnecessary biopsies with the risk of missing clinically significant pathology. Although TVS is useful for initial assessment, it cannot reliably differentiate all benign, premalignant, and malignant endometrial lesions on its own.[7] Histopathological examination remains the reference standard because it provides definitive tissue diagnosis and allows classification of normal endometrium, endometrial hyperplasia, atypical hyperplasia, and carcinoma. This is particularly important in women with persistent post-menopausal bleeding, focal lesions, heterogeneous endometrial pattern, or risk factors for endometrial carcinoma. In resource-limited settings, however, TVS remains valuable as a triage tool because it is accessible, non-invasive, relatively inexpensive, and useful for identifying women who require endometrial sampling.[8,9] Despite the routine use of TVS in clinical practice, local evidence regarding its diagnostic performance in post-menopausal women remains limited. In addition, cutoff variability has not been adequately evaluated in many local studies, and reliance on a single fixed threshold may lead to either missed cases or unnecessary invasive procedures. Therefore, this study was conducted to determine the diagnostic accuracy of transvaginal ultrasonography in detecting histopathologically confirmed endometrial pathology in post-menopausal women, using histopathological examination as the reference standard. The study also aimed to evaluate the diagnostic performance of endometrial thickness and compare the predefined >10 mm cutoff with an ROC-derived optimal cutoff.

METHODOLOGY

This study was a descriptive, cross-sectional diagnostic accuracy study to evaluate the role of transvaginal ultrasonography in detecting endometrial hyperplasia in post-menopausal women, using histopathological examination as the reference standard. The study was reported in accordance with the key principles of the Standards for Reporting of Diagnostic Accuracy Studies (STARD), including clear definition of the index test, reference standard, participant eligibility, diagnostic cutoff, and measures of diagnostic precision. The study was carried out at the Department of Radiology, MTI Bacha Khan Medical College and Mardan Medical Complex, Mardan, from 9th February to 9th April. Ethical approval was obtained from the Ethical Review Board of Bacha Khan Medical College, Mardan, with reference number 98/BKMC, dated 09/02/2026. A total of 93 post-menopausal women were included in the study. The sample size was calculated using the WHO sample size formula, a 95% confidence level, P was assumed to be 50% due to variability in reported prevalence of endometrial pathology in previous literature, and the margin of error was set at 10%, giving a required sample size of 93 participants. Because reliable local estimates of sensitivity and specificity for transvaginal ultrasonography in this population were limited, a prevalence-based estimate was used for recruitment feasibility; however, diagnostic precision was addressed in the revised analysis by reporting 95% confidence intervals for sensitivity, specificity, predictive values, and diagnostic accuracy.[9] A non-probability consecutive sampling technique was used, and all eligible patients presenting during the study period were enrolled until the required sample size was achieved. The study included post-menopausal women aged 45 and above with bleeding or suspected endometrial issues who underwent transvaginal ultrasonography and endometrial sampling. Exclusions were women with endometrial carcinoma, incomplete records, refusals, or hormonal treatments affecting endometrial thickness. Inclusion of symptomatic cases aimed to mirror clinical practice but may introduce spectrum bias due to varying disease severity. After obtaining written informed consent, demographic and clinical data were collected using a structured pro forma, including age, body mass index, parity, post-menopausal bleeding, diabetes mellitus, hypertension, hormone replacement therapy, and other relevant variables. All participants underwent transvaginal ultrasonography (TVUS), performed by trained radiologists using a standardized protocol. Radiologists were blinded to histopathology findings to minimize observer bias. Endometrial thickness was measured in millimeters on the sagittal plane as the maximum double-layer thickness between the endometrial-myometrial interfaces. Additional findings, including endometrial pattern, echogenicity, and focal lesions, were also recorded. Endometrial thickness was categorized as ≤4 mm, 5–10 mm, and >10 mm. For diagnostic accuracy analysis, >10 mm was considered TVUS-positive, while ≤10 mm was considered TVUS-negative. Following TVUS, all participants underwent endometrial sampling, and histopathology served as the reference standard. Specimens were classified as normal endometrium, endometrial hyperplasia, or endometrial carcinoma by blinded pathologists using standard diagnostic criteria. For analysis, normal endometrium was considered histopathology-negative, whereas hyperplasia and carcinoma were considered histopathology-positive.

Consecutive sampling was used to reduce selection bias; however, some spectrum bias may have remained due to inclusion of women with post-menopausal bleeding and suspected endometrial pathology. Data were entered and analyzed using IBM SPSS version 25. Quantitative variables, including age, body mass index, and endometrial thickness, were reported as mean ± standard deviation, along with minimum and maximum values, whereas qualitative variables were presented as frequencies and percentages. The Chi-square test was used to assess associations between categorical variables, and Cramér's V was used to assess the strength of association between endometrial thickness categories and histopathological findings. A p-value of ≤0.05 was considered statistically significant. Diagnostic accuracy of transvaginal ultrasonography (TVUS) at the predefined cutoff of endometrial thickness >10 mm was evaluated using histopathology as the reference standard. Sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy with 95% confidence intervals were calculated. A two-by-two contingency table was used to classify cases as true positives, false positives, false negatives, and true negatives. Receiver operating characteristic (ROC) curve analysis was performed using endometrial thickness as a continuous variable, with histopathological diagnosis as the outcome. The area under the curve (AUC), 95% confidence interval, and p-value were reported, and the optimal cutoff value was identified using the Youden index (sensitivity + specificity − 1).

RESULTS

The study included 93 post-menopausal women. The mean age of the participants was 58.8 ± 8.8 years, with ages ranging from 45 to 75 years. The mean body mass index was 27.7 ± 3.6 kg/m², with 36 (38.7%) participants classified as overweight and 29 (31.2%) as obese.

Table 1: Demographic and Clinical Characteristics of Participants (n = 93)

Variable	Category	Frequency (%)
Age group	45-55 years	37 (39.8%)
	56-65 years	33 (35.5%)
	>65 years	23 (24.7%)
BMI category	Normal	28 (30.1%)
	Overweight	36 (38.7%)
	Obese	29 (31.2%)
Post-menopausal bleeding	Yes	45 (48.4%)
	No	48 (51.6%)
Parity	Multiparous	52 (55.9%)
	Nulliparous	41 (44.1%)
Diabetes mellitus	Yes	55 (59.1%)
	No	38 (40.9%)
Hypertension	Yes	47 (50.5%)
	No	46 (49.5%)
Hormone replacement therapy	Yes	44 (47.3%)
	No	49 (52.7%)

Table 2: Transvaginal Ultrasonography and Histopathological Findings (n = 93)

Variable	Category	Frequency (%)
Endometrial Thickness category	≤4 mm	14 (15.1%)
	5–10 mm	43 (46.2%)
	>10 mm	36 (38.7%)
Endometrial pattern	Homogeneous	50 (53.8%)
	Heterogeneous	43 (46.2%)
Echogenicity	Hyperechoic	36 (38.7%)
	Hypoechoic	34 (36.6%)
	Mixed	23 (24.7%)
Focal lesion	Yes	49 (52.7%)
	No	44 (47.3%)
Histopathological diagnosis	Normal endometrium	31 (33.3%)
	Endometrial hyperplasia	52 (55.9%)
	Endometrial carcinoma	10 (10.8%)
Histopathology outcome	Positive endometrial pathology	62 (66.7%)
	Negative finding	31 (33.3%)

Table 3: Association of Endometrial Thickness Category with Histopathology-Positive Endometrial Pathology (n = 93)

Endometrial thickness	Histopathology-positive n (%)	
	positive n (%)	negative n (%)
≤4 mm	0 (0.0%)	14 (100.0%)
5–10 mm	26 (60.5%)	17 (39.5%)
>10 mm	36 (100.0%)	0 (0.0%)

Note: Chi-square test applied; $\chi^2 = 46.744$, df = 2, $p < 0.001$; Cramer's V = 0.709.

Table 4: Diagnostic Accuracy of Transvaginal Ultrasonography at ET >10 mm Cutoff (n = 93)

Diagnostic parameter	Value	95% CI
True positive	36	—
False positive	0	—
False negative	26	—
True negative	31	—
Sensitivity	58.1%	45.7–69.5
Specificity	100.0%	89.0–100.0
Positive predictive value	100.0%	90.4–100.0
Negative predictive value	54.4%	41.6–66.6
Diagnostic accuracy	72.0%	62.2–80.1

Note: Chi-square test applied; $\chi^2 = 29.368$, $p < 0.001$; Cramer's V = 0.562.

Table 5: Two-by-Two Diagnostic Accuracy Table for TVS Cutoff >10 mm

TVS result	Histopathology-positive	
	positive	negative
Positive >10 mm	36	0
Negative ≤10 mm	26	31

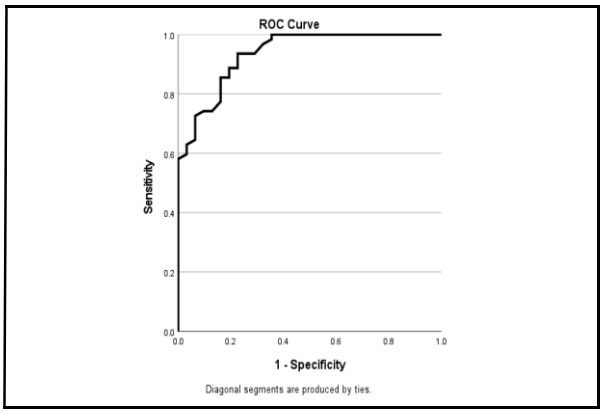

Figure 1: ROC Curve Analysis of Endometrial Thickness for Histopathology-Positive Endometrial Pathology (area under the curve was 0.935 (95% CI: 0.887–0.984; p < 0.001), and the optimal cutoff by the Youden index was ≥5.65 mm).

DISCUSSION

The present study evaluated the diagnostic performance of transvaginal ultrasonography (TVS) for detecting histopathologically confirmed endometrial pathology in post-menopausal women. The mean age was 58.8 ± 8.8 years, comparable to previous studies on post-menopausal bleeding and suspected endometrial disease.[10] A high proportion of participants were overweight/obese and had diabetes or hypertension, supporting the established association between metabolic dysfunction and endometrial proliferation.[11,12,13] Histopathology showed that 52 women had endometrial hyperplasia and 10 had endometrial carcinoma, while 31 had normal endometrium. For diagnostic accuracy analysis, hyperplasia and carcinoma were grouped as histopathology-positive endometrial pathology because both represent clinically significant abnormal findings requiring further evaluation or management. The proportion of abnormal histopathological findings was higher than that reported in some international cohorts, but the hospital-based nature of the study and inclusion of women with post-menopausal bleeding or suspected endometrial pathology may explain this. Similar variation has been reported in studies in which disease prevalence differs according to symptoms, referral setting, and biopsy threshold.[14] The mean endometrial thickness in this study was 8.45 ± 3.67 mm, and greater endometrial thickness was significantly associated with histopathologically positive findings. None of the women with endometrial thickness ≤4 mm had abnormal histopathology, whereas all women with thickness >10 mm had histopathology-positive disease. This finding supports the role of endometrial thickness as an important sonographic marker; however, thickness alone cannot fully differentiate benign hyperplasia, atypical hyperplasia, and carcinoma. Therefore, TVS should be interpreted along with clinical risk factors and histopathological confirmation.[15,16] At the >10 mm cutoff, transvaginal ultrasonography demonstrated a sensitivity of 58.1% and a specificity of 100%. This strong rule-in value yielded no false positives, but the moderate sensitivity led to many histopathology-positive cases being missed. Additionally, the negative predictive value was limited because endometrial thickness ≤10 mm did not reliably exclude disease. Therefore, despite high specificity, the overall diagnostic reliability is questionable due to the influence of disease prevalence in this study population. Several factors may account for the moderate sensitivity observed in this study. A higher cutoff, such as >10 mm, increases specificity but may reduce sensitivity, potentially leading to the omission of early or less extensive hyperplastic changes. Additionally, histopathology-positive cases vary widely, from hyperplasia to carcinoma, and not all lesions cause significant endometrial thickening. Focal lesions can exist even with normal overall thickness, indicating that relying on a single cutoff may overlook important disease. Similar variability in sensitivity and specificity has been reported in the literature, driven by factors such as cutoff selection, study population, and operator expertise.[17,18,19] The ROC curve analysis improved diagnostic interpretation by continuously assessing endometrial thickness rather than relying solely on the >10 mm threshold. The AUC was 0.935, indicating excellent performance. The optimal cutoff identified through the Youden index was ≥5.65 mm, yielding sensitivity of 93.5% and specificity of 77.4%. This suggests a lower cutoff is better for screening to reduce missed cases, while the >10 mm threshold is more appropriate for ruling in pathology with higher specificity. This illustrates the sensitivity-specificity trade-off and emphasizes the importance of cutoff selection based on clinical goals. Additionally, the findings align with previous studies showing that TVS diagnostic performance varies widely across populations, depending on factors such as menopausal status and bleeding symptoms. (19). Comparative studies indicate that while hysteroscopy and histopathology offer greater diagnostic certainty, TVS remains a valuable, non-invasive first-line assessment for post-menopausal women.[20] The study suggests that transvaginal sonography (TVS) should not be used alone to rule out endometrial issues, especially with ongoing clinical suspicion. A threshold of >10 mm may indicate a higher disease probability, although a lower threshold (≥5.65 mm) could be better for screening. In resource-limited settings, TVS can aid risk stratification and biopsy prioritization, but histopathological examination

remains essential for a definitive diagnosis. Overall, TVS is a useful initial assessment tool for endometrial pathology in post-menopausal women, particularly when thickness is significantly increased, though its moderate sensitivity requires thoughtful clinical interpretation.

LIMITATIONS

The study was limited by non-probability, consecutive sampling; possible spectrum bias; lack of inter-observer variability assessment; and the use of a prevalence-based sample size formula.

CONCLUSIONS

Transvaginal ultrasonography is a useful, non-invasive initial modality for evaluating endometrial pathology in post-menopausal women. In this study, the predefined endometrial thickness cutoff of >10 mm showed excellent specificity and positive predictive value but only moderate sensitivity, suggesting that this threshold is more useful for ruling in disease than for ruling it out. ROC curve analysis showed excellent discriminatory performance of endometrial thickness, with an AUC of 0.935. The ROC-derived optimal cutoff of ≥5.65 mm provided higher sensitivity and may be more suitable for screening, although it had lower specificity than the >10 mm cutoff. Therefore, TVS should be interpreted in relation to clinical presentation, risk factors, and the purpose of testing. A higher cutoff may confirm a high probability of pathology, while a lower cutoff may reduce the risk of missed cases during screening. Histopathological examination remains the reference standard for definitive diagnosis, particularly in symptomatic women or those with persistent clinical suspicion. The findings should be interpreted with consideration of the study limitations, including consecutive non-probability sampling, possible spectrum bias, and the need to validate the ROC-derived cutoff in larger studies.

CONFLICT OF INTEREST: None

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AUTHORS CONTRIBUTION

Tabassum Begum *- Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Critical Revision; Supervision; Final Approval*

Sumaira Noureen - *Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Critical Revision; Supervision; Final Approval*

Neelofar Azam - *Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Critical Revision; Supervision; Final Approval*

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The authors accept responsibility for all aspects of the work and will ensure that any concerns regarding the accuracy or integrity of any part are properly investigated and resolved.