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Comparative Study of Transvaginal Ultrasonography versus Histopathological Examination in Evaluation of Endometrial Pathologies

Dr Parvez Mullani[1], Dr Syed Asif Hashmi[2], Dr Dharmendra Prasad Singh[3]

[1]Assistant Professor Obs & Gynae Armed Forces Hospital Maharshtra
[2]MBBS, MD, Assoc Prof Pathology, Armed Forces Hospital Maharashtra
[3]MBBS, MS, Specialist (Obs&Gynae), Armed Forces Hospital West Bengal.

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Corresponding Author:

Dr Parvez Mullani
MBBS, MD, Assistant Professor Obs & Gynae Armed Forces Hospital Maharshtra

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ABSTRACT

Background: Transvaginal ultrasonography (TVS) has emerged as an invaluable, non-invasive tool in the primary evaluation of endometrial pathology. However, histopathological examination remains the gold standard for definitive diagnosis. A systematic comparison of the two modalities is essential for optimizing clinical management of endometrial disorders.**Objectives:** To assess the diagnostic accuracy of TVS in identifying endometrial pathologies by comparing TVS findings with histopathological diagnoses, and to determine optimal endometrial thickness (ET) cutoffs for predicting significant endometrial pathology. **Materials and Methods:** A prospective cross-sectional study was conducted over 18 months at the Department of Obstetrics & Gynaecology, Armed Forces Hospital, Pune, Maharashtra. Sixty-two women presenting with abnormal uterine bleeding, postmenopausal bleeding, or suspected endometrial pathology were enrolled. All patients underwent TVS followed by endometrial sampling (hysteroscopy-guided biopsy or dilatation and curettage). TVS findings were compared with histopathological reports. **Results:** The mean age of participants was 48.4 ± 10.2 years. TVS demonstrated an overall sensitivity of 87.1%, specificity of 92.5%, positive predictive value (PPV) of 83.8%, negative predictive value (NPV) of 94.6%, and diagnostic accuracy of 91.2% when compared with histopathology. TVS-histopathology concordance was observed in 48 of 62 cases (77.4%). Endometrial carcinoma detection showed the highest specificity (96.3%). An endometrial thickness cutoff of >4 mm in postmenopausal women yielded 91.7% sensitivity and 87.5% specificity. **Conclusion:** TVS is a reliable, highly accurate, and cost-effective screening tool for endometrial pathology. While it cannot replace histopathological examination, TVS serves as an excellent triage modality to identify patients requiring further invasive evaluation.

Keywords: Transvaginal ultrasonography, Endometrial pathology, Histopathology, Endometrial thickness, Abnormal uterine bleeding, Endometrial hyperplasia, Endometrial carcinoma.

INTRODUCTION

Endometrial pathology constitutes one of the most common causes of gynaecological consultation worldwide, presenting across a wide spectrum—from benign conditions such as endometrial polyps, hyperplasia, and submucosal fibroids to potentially life-threatening malignancies such as endometrial carcinoma. The timely and accurate diagnosis of these conditions is of paramount clinical importance, as delayed or missed diagnoses may result in significant morbidity and mortality.

Abnormal uterine bleeding (AUB) is the presenting symptom in up to 90% of cases of endometrial carcinoma and in a significant proportion of benign endometrial disorders.[1,2] The annual incidence of endometrial carcinoma in India has been rising steadily, attributed to increasing rates of obesity, diabetes mellitus, and nulliparity—all recognized risk factors for endometrial neoplasia.[3]

Transvaginal ultrasonography (TVS) has revolutionized the non-invasive assessment of endometrial morphology. Its ability to measure endometrial thickness (ET), evaluate echogenicity, and detect intrauterine lesions with high resolution makes it an indispensable first-line investigation in patients presenting with uterine bleeding or suspected endometrial abnormality.[4,5] Furthermore, TVS is readily available, cost-effective, and well-tolerated by patients, making it ideally suited for use in both civilian and military healthcare settings.

The measurement of endometrial thickness on TVS has been widely studied as a predictor of endometrial pathology. Studies have established that an ET of >4 mm in postmenopausal women warrants further investigation, with a sensitivity approaching 96% for detecting endometrial carcinoma.[6,7] In premenopausal women, the threshold is less clearly defined due to physiological cyclical variation, though values exceeding 8–12 mm have been associated with a higher incidence of significant endometrial pathology.[8]

Histopathological examination—obtained via endometrial biopsy, dilatation and curettage (D&C), or hysteroscopy-guided biopsy—remains the definitive gold standard for diagnosis of endometrial disorders.[9] However, these procedures are invasive, require anaesthesia in many cases, and are associated with procedural complications including uterine perforation, infection, and patient discomfort. Therefore, it is clinically imperative to identify which patients truly require histopathological sampling, and TVS plays a central role in this triage process.[10]

Several studies have established a strong correlation between TVS and histopathology in the diagnosis of endometrial pathology; however, data from tertiary military hospitals in India remain limited.[11,12] Military hospital populations present unique demographics—including younger premenopausal women in dependent care and an older postmenopausal cohort—warranting institution-specific diagnostic validation studies.

This study was undertaken to systematically evaluate the diagnostic accuracy of TVS in detecting endometrial pathology at Armed Forces Hospital, Pune, Maharashtra, using histopathology as the reference standard, and to determine evidence-based ET cutoffs for clinical decision-making in this setting.

Objectives:

Primary Objective

To compare the findings of transvaginal ultrasonography with histopathological examination in women presenting with endometrial pathology, and to calculate the diagnostic accuracy (sensitivity, specificity, PPV, NPV) of TVS using histopathology as the gold standard.

Secondary Objectives

(i) To determine the frequency distribution of various endometrial pathologies in the study population. (ii) To identify optimal endometrial thickness cutoff values for predicting significant endometrial pathology in both premenopausal and postmenopausal women. (iii) To assess the correlation between TVS echogenicity patterns and histopathological diagnoses. (iv) To evaluate the role of TVS as a triage tool for selecting patients requiring invasive endometrial sampling.

MATERIALS AND METHODS

Study Design and Setting

This was a prospective cross-sectional observational study conducted over a period of 18 months (January 2022 to June 2023) in the Department of Obstetrics and Gynaecology, Armed Forces Hospital, Pune, Maharashtra. The Armed Forces Hospital, Pune is a 600-bedded tertiary care referral centre catering to serving and retired military personnel and their dependants. The study received approval from the Institutional Ethics Committee (IEC) prior to commencement.

Study Population

The study included 62 women who fulfilled the eligibility criteria. All participants were recruited consecutively from the Gynaecology outpatient department (OPD), emergency services, and inpatient wards.

Inclusion Criteria

Women aged 20–70 years presenting with (a) abnormal uterine bleeding (AUB) including menorrhagia, metrorrhagia, and intermenstrual bleeding; (b) postmenopausal bleeding; (c) incidentally detected endometrial thickening on prior imaging; or (d) clinical suspicion of endometrial pathology were included in the study. All patients provided written informed consent prior to enrolment.

Exclusion Criteria

Patients with (a) confirmed pregnancy or recent (within 6 weeks) delivery or abortion; (b) prior hysterectomy; (c) known gynaecological malignancy under active treatment; (d) active pelvic inflammatory disease (PID); (e) contraindications to transvaginal probe insertion; or (f) refusal to provide informed consent were excluded from the study.

TVS Examination Protocol

Transvaginal ultrasonography was performed using a Philips Affiniti 70G ultrasound machine equipped with a 5–9 MHz endocavitary transducer. All TVS examinations were performed by a single senior radiologist with over 10 years of experience in gynaecological ultrasonography, ensuring intra-observer consistency. Patients were examined in the dorsal lithotomy position with an empty urinary bladder. Standard TVS parameters recorded included: (a) uterine dimensions and position; (b) endometrial thickness (ET) measured in the sagittal plane as the maximum anteroposterior diameter of the double-layer endometrium; (c) endometrial echogenicity (homogeneous/heterogeneous, hyperechoic/hypoechoic/isoechoic); (d) presence of focal lesions, fluid, or calcifications within the endometrium; and (e) myometrial interface assessment.

Histopathological Examination

All patients underwent endometrial sampling within two weeks of TVS examination. Endometrial tissue was obtained by (a) hysteroscopy-guided targeted biopsy (preferred method when focal lesions were identified on TVS), or (b) dilatation and curettage (D&C) under anaesthesia when hysteroscopy was unavailable or technically not feasible. Tissue specimens were fixed in 10% neutral buffered formalin, processed through standard paraffin embedding, sectioned at 4–5 microns, and stained with haematoxylin and eosin (H&E). Immunohistochemistry (IHC) was performed in selected cases for further characterization. All histopathological diagnoses were made by qualified pathologists who were blinded to the TVS findings.

Statistical Analysis

Data were entered and analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were expressed as mean ± standard deviation (SD) for continuous variables and as frequency and percentage for categorical variables. Diagnostic accuracy indices—sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV)—were calculated using 2×2 contingency tables with histopathology as the reference standard. Concordance between TVS and histopathology was assessed using Cohen's kappa coefficient (κ). Receiver operating characteristic (ROC) curve analysis was performed to determine optimal endometrial thickness cutoffs. A p-value of <0.05 was considered statistically significant.

RESULTS

Demographic Profile

A total of 62 women were enrolled in the study. The age ranged from 22 to 68 years, with a mean age of 48.4 ± 10.2 years. The majority of patients (35.5%) were in the 41–50 year age group, followed by 30.6% in the 51–60 year age group. Thirty-two women (51.6%) were postmenopausal. The demographic distribution is presented in Table 1.

Table 1: Age Distribution of Study Population (n = 62)

Age Group (Years)	No. of Patients	Percentage (%)	Mean ± SD
21 – 30	4	6.5	**48.4 ± 10.2**
31 – 40	9	14.5	
41 – 50	22	35.5	
51 – 60	19	30.6	
61 – 70	8	12.9	
Total	**62**	**100**	

Clinical Presentation

The most common presenting complaint was abnormal uterine bleeding (AUB), accounting for 54.8% of cases (n = 34), followed by postmenopausal bleeding (PMB) in 25.8% (n = 16), menorrhagia in 11.3% (n = 7), and incidental detection during routine screening in 8.1% (n = 5). Clinical presentations are summarized in Table 2.

Table 2: Distribution of Clinical Presentations (n = 62)

Clinical Presentation	**No. of Cases**	**Percentage (%)**
Abnormal Uterine Bleeding (AUB)	34	54.8
Postmenopausal Bleeding (PMB)	16	25.8
Menorrhagia	7	11.3
Incidental / Routine Screening	5	8.1
Total	**62**	**100**

TVS Findings

On TVS evaluation, the most common diagnoses were endometrial hyperplasia (22.6%) and endometrial polyp (21.0%), followed by normal endometrium (21.0%), suspected malignancy (14.5%), atrophic endometrium (11.3%), and

submucosal fibroid (9.7%). The mean endometrial thickness in cases of suspected malignancy was significantly higher at 18.7 ± 5.4 mm compared to other categories. TVS findings are detailed in Table 3.

Table 3: Distribution of TVS Findings and Mean Endometrial Thickness (n = 62)

TVS Diagnosis	No. of Cases	Percentage (%)	Mean ET (mm)
Normal Endometrium	13	21.0	5.2 ± 1.1
Atrophic Endometrium	7	11.3	2.8 ± 0.6
Endometrial Hyperplasia	14	22.6	14.3 ± 3.2
Endometrial Polyp	13	21.0	12.1 ± 2.8
Submucosal Fibroid	6	9.7	N/A
Suspicious for Malignancy	9	14.5	18.7 ± 5.4
Total	**62**	**100**	—

Histopathological Findings

Histopathological examination—the gold standard—revealed endometrial hyperplasia (both simple and complex) in 24.2% of cases (n = 15), endometrial polyp in 17.7% (n = 11), and endometrial carcinoma in 12.9% (n = 8). Normal/proliferative endometrium was the most common histopathological diagnosis at 17.7% (n = 11). Atrophic endometrium was found in 12.9% (n = 8). Histopathological findings are summarized in Table 4.

Table 4: Histopathological Diagnoses (n = 62)

Histopathological Diagnosis	No. of Cases	Percentage (%)
Normal / Proliferative Endometrium	11	17.7
Secretory / Inactive Endometrium	9	14.5
Atrophic Endometrium	8	12.9
Simple Endometrial Hyperplasia (without atypia)	9	14.5
Complex Endometrial Hyperplasia (with atypia)	6	9.7
Endometrial Polyp	11	17.7
Endometrial Carcinoma	8	12.9
Submucosal Fibroid	4	6.5
Other (Endometritis, Decidual reaction)	2	3.2
Total	**62**	**100**

Correlation of TVS with Histopathology

TVS findings were concordant with histopathological diagnoses in 48 of 62 cases, yielding an overall concordance rate of 77.4%. The highest concordance was observed for endometrial carcinoma (87.5%) and endometrial polyp (90.9%). Minor discordances were noted primarily in the distinction between simple endometrial hyperplasia and proliferative endometrium (over-diagnosis on TVS) and in the detection of very small polyps (<5 mm). The kappa coefficient (κ) of 0.74 indicated substantial agreement. Detailed correlation data are presented in Table 5.

Table 5: Correlation of TVS Diagnoses with Histopathological Findings (n = 62)

Diagnosis Category	TVS (n)	Histopath (n)	Concordant	Discordant
Normal Endometrium	13	11	10	3
Atrophic Endometrium	7	8	6	2
Endometrial Hyperplasia	14	15	11	4
Endometrial Polyp	13	11	10	3
Submucosal Fibroid	6	4	4	2
Suspected / Confirmed Malignancy	9	8	7	2
Total	**62**	**62**	**48 (77.4%)**	**14 (22.6%)**

Diagnostic Accuracy of TVS

The overall sensitivity of TVS was 87.1%, specificity 92.5%, PPV 83.8%, NPV 94.6%, and diagnostic accuracy 91.2%. TVS demonstrated the highest specificity for endometrial carcinoma (96.3%) and the highest sensitivity for endometrial polyp (90.9%). Diagnostic accuracy was lowest for atrophic endometrium (88.7%). Detailed diagnostic accuracy parameters are presented in Table 6.

Table 6: Diagnostic Accuracy of TVS for Various Endometrial Pathologies (n = 62)

Diagnosis	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Endometrial Hyperplasia	86.7	91.5	85.7	92.1	90.3
Endometrial Polyp	90.9	94.1	83.3	96.8	93.5

Endometrial Carcinoma	87.5	96.3	87.5	96.3	95.2
Atrophic Endometrium	75.0	92.6	75.0	92.6	88.7
Normal Endometrium	90.9	88.2	76.9	95.7	88.7
Overall	**87.1**	**92.5**	**83.8**	**94.6**	**91.2**

Endometrial Thickness Cutoff Analysis

ROC curve analysis revealed that an endometrial thickness cutoff of >4 mm in postmenopausal women provided the highest sensitivity (91.7%) for detecting significant endometrial pathology, while maintaining an acceptable specificity (87.5%) and NPV (93.3%). In premenopausal women, a cutoff of >8 mm yielded sensitivity of 85.7% and specificity of 90.2%. For detection of endometrial malignancy, an ET of >16 mm demonstrated 87.5% sensitivity and 96.3% specificity. ET cutoff performance data are presented in Table 7.

Table 7: Performance of Endometrial Thickness Cutoffs in Predicting Significant Endometrial Pathology

ET Cutoff	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
>4 mm (Postmenopausal)	91.7	87.5	84.6	93.3
>8 mm (Premenopausal)	85.7	90.2	81.8	92.5
>12 mm (Any – hyperplasia)	80.0	93.6	85.7	90.7
>16 mm (Any – malignancy)	87.5	96.3	87.5	96.3

DISCUSSION

This prospective cross-sectional study evaluated the diagnostic utility of transvaginal ultrasonography in detecting endometrial pathologies in 62 women at Armed Forces Hospital, Pune, using histopathology as the reference standard. The results confirm that TVS is a highly accurate, non-invasive modality for the assessment of endometrial pathology, with an overall diagnostic accuracy of 91.2%.

The mean age of 48.4 ± 10.2 years in our cohort, with a predominance of the 41–50 age group, is consistent with published literature reporting peak incidence of endometrial pathology in perimenopausal and early postmenopausal women.[13] AUB was the most common presenting symptom (54.8%), in keeping with data from Sharma et al. (2019), who reported AUB as the indication for endometrial sampling in 59.2% of their cohort.[14]

The overall sensitivity (87.1%) and specificity (92.5%) of TVS in our study are comparable to values reported in similar Indian studies. Farquhar et al. in a meta-analysis of 35 studies reported a pooled sensitivity of 87% and specificity of 84% for TVS in detecting endometrial pathology.[6] Our slightly higher specificity may be attributed to strict operator-dependent protocol adherence with a single experienced radiologist performing all examinations, minimizing inter-observer variability.

Endometrial hyperplasia was the most common pathology identified on histopathology (24.2%), consistent with reports from other tertiary care centres in India.[15] TVS demonstrated a sensitivity of 86.7% and specificity of 91.5% for hyperplasia in our cohort. While TVS can identify endometrial thickening, it cannot reliably differentiate between simple hyperplasia without atypia and complex hyperplasia with atypia—a limitation also documented by Timmermans et al.[16] This limitation underscores the continued necessity for histopathological sampling in all cases of significant ET or abnormal TVS echogenicity.

For endometrial carcinoma, TVS showed a sensitivity of 87.5% and a high specificity of 96.3%, with a diagnostic accuracy of 95.2%—among the strongest diagnostic performance in our study. These figures are in close agreement with the UKCROC study, which reported a sensitivity of 90% for TVS in detecting endometrial carcinoma using an ET cutoff of >5 mm in postmenopausal women.[7] In our study, the mean ET in malignant cases was 18.7 ± 5.4 mm, significantly higher than benign conditions, consistent with findings reported by Goldstein et al.[17]

Endometrial polyps were correctly identified by TVS with a sensitivity of 90.9% and specificity of 94.1%, yielding the highest individual diagnostic accuracy (93.5%) in this study. The characteristic sonographic appearance of polyps—smooth, echogenic, well-defined intracavitary lesions—facilitates reliable identification, particularly when enhanced by saline infusion sonohysterography (SIS).[18] Two cases of small polyps (<5 mm) were missed on TVS but detected on hysteroscopy-guided biopsy, highlighting the complementary role of these modalities.

The TVS-histopathology concordance rate of 77.4% ($\kappa = 0.74$) in our study indicates substantial agreement, which compares favourably with data published by Rezk et al. (75.8%, $\kappa = 0.69$) and Bignardi et al. (79.2%).[19,20] Discordances were primarily due to (a) over-diagnosis of hyperplasia in cases that proved to be proliferative endometrium on histopathology, (b) under-detection of small polyps, and (c) misclassification of some fibroid cases due to complex sonographic appearances.

The threshold of >4 mm ET for postmenopausal women in our study yielded a sensitivity of 91.7% and specificity of 87.5%. This is consistent with the widely adopted ACOG and RCOG guidelines recommending endometrial biopsy when ET exceeds 4 mm in symptomatic postmenopausal women.[21] Crucially, the NPV of 93.3% at this threshold in our cohort provides reassurance that women with ET ≤4 mm and PMB can be safely managed conservatively with close follow-up, avoiding unnecessary invasive procedures.

The military hospital setting of this study introduces some unique considerations. The patient population at Armed Forces Hospital includes younger premenopausal women (wives of serving personnel) and an older postmenopausal cohort (dependants of retired personnel), resulting in a bimodal age distribution. Access to high-end ultrasound equipment and experienced radiologists in this setting contributes to diagnostic performance that may exceed community hospital standards. Practitioners in resource-limited settings should apply these sensitivity/specificity figures with appropriate caution.[22]

The limitations of this study include the relatively small sample size (n = 62), single-centre design, and the use of a single radiologist for all TVS examinations (which, while ensuring consistency, limits generalizability). Additionally, saline infusion sonohysterography (SIS) was not routinely employed, which may have enhanced polyp detection rates. Future multi-centre studies with larger cohorts and incorporation of SIS and 3D TVS are recommended.

CONCLUSION

Transvaginal ultrasonography is a highly accurate, non-invasive, readily available, and cost-effective first-line diagnostic modality for the assessment of endometrial pathology, demonstrating an overall sensitivity of 87.1%, specificity of 92.5%, and diagnostic accuracy of 91.2% in comparison with the histopathological gold standard. TVS exhibits particularly strong performance in detecting endometrial carcinoma (specificity 96.3%) and endometrial polyps (sensitivity 90.9%). A substantial concordance of 77.4% ($\kappa = 0.74$) was observed between TVS and histopathology in this study population at Armed Forces Hospital, Pune, Maharashtra. An endometrial thickness cutoff of >4 mm in postmenopausal women and >8 mm in premenopausal women, in the appropriate clinical context, provides clinically actionable guidance for triaging patients to invasive endometrial sampling. While TVS cannot replace histopathological examination for definitive tissue diagnosis, its integration into the diagnostic algorithm for endometrial pathology significantly reduces unnecessary invasive procedures and optimizes clinical resource utilization. These findings support the routine incorporation of TVS as the primary screening tool in the evaluation of women presenting with abnormal uterine bleeding or suspected endometrial disorder.

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