Section: Obstetrics and Gynaecology

Original Research Article

EVALUATING ENDOMETRIAL THICKNESS AND VOLUME VIA TRANSVAGINAL 3D ULTRASOUND: A STUDY ON PERIMENOPAUSAL BLEEDING

Kanika Chandra[1], Neha Panwar[2], Parikshit Morey[3]

[1,2]Assistant Professor, Department of Obstetrics and Gynaecology, Gautam Buddha Chikitsa Mahavidyalaya, Subharti Medical College, Dehradun, Uttarakhand, India
[3]Consultant Radiologist, Synergy Institute of Medical Sciences, Dehradun, Uttarakhand, India.

Received *: 07/02/2025*
Received in revised form *: 19/03/2025*
Accepted *: 05/04/2025*

Corresponding Author:
Dr. Kanika Chandra,
Department of Obstetrics and Gynaecology, Gautam Buddha Chikitsa Mahavidyalaya, Subharti Medical College, Dehradun, Uttarakhand, India.
Email: kanikachandra24@gmail.com

DOI: 10.70034/ijmedph.2025.2.72

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

Int J Med Pub Health
2025; 15 (2); 400-403

ABSTRACT

Background: Abnormal uterine bleeding (AUB) in perimenopausal women is a common clinical challenge that may indicate underlying endometrial pathology. **Aim:** This study aimed to evaluate the diagnostic role of endometrial thickness and volume, measured by transvaginal three-dimensional ultrasound, in predicting abnormal endometrial histopathology.
Materials and Methods: A prospective observational study was conducted on 60 perimenopausal women with AUB at a tertiary hospital in for a period of 1 year. Endometrial thickness and volume were measured using 3D transvaginal ultrasound, followed by histopathological evaluation.
Results: Endometrial thickness and volume were significantly higher in cases with malignancy and hyperplasia with atypia compared to benign pathologies ($p < 0.001$). The combination of both parameters improved diagnostic sensitivity.
Conclusion: Endometrial thickness and volume measured by 3D ultrasound serve as reliable predictors of endometrial pathology in perimenopausal AUB, supporting their use in clinical decision-making.
Keywords: Abnormal uterine bleeding, Endometrial thickness, 3D transvaginal ultrasound.

INTRODUCTION

Abnormal uterine bleeding (AUB) during the perimenopausal period is a common clinical complaint, posing a diagnostic challenge for gynecologists due to its varied etiology ranging from benign hormonal imbalances to significant endometrial pathology, including hyperplasia and carcinoma. In India, the burden of AUB in perimenopausal women is substantial, impacting both quality of life and health economics due to the need for repeated consultations and interventions.[1]
Conventionally, endometrial biopsy has been the gold standard for evaluating endometrial pathology; however, it is invasive, uncomfortable, and not always feasible as a first-line diagnostic modality. In this context, transvaginal sonography (TVS) has emerged as a valuable, non-invasive imaging tool to assess endometrial characteristics, especially in symptomatic perimenopausal women.[2] Among the advances in imaging, three-dimensional (3D) transvaginal ultrasound provides more accurate and reproducible measurements of endometrial volume in addition to thickness, which can enhance diagnostic sensitivity.[3]
Several studies have demonstrated that increased endometrial thickness, as measured by TVS, is associated with a higher likelihood of abnormal endometrial pathology.[4,5] However, recent evidence suggests that endometrial volume, as measured by 3D ultrasound, may be a more reliable parameter than thickness alone in predicting malignancy and premalignant lesions.[6] Furthermore, the ability of 3D TVS to provide a coronal view of the endometrium allows for better spatial orientation and assessment of focal lesions like polyps or submucosal fibroids, which might otherwise go undetected.[7]
Indian women, particularly in the perimenopausal age group, face a unique combination of socio-cultural and biological factors that can delay the reporting and management of AUB. Hence, a

sensitive, cost-effective, and accessible diagnostic tool such as 3D TVS could significantly improve early detection of endometrial pathology in this demographic.[8] Moreover, the integration of endometrial thickness and volume measurements may offer a combined diagnostic value, guiding clinicians toward timely biopsy and intervention only when necessary.[9]

Given this background, our study aims to evaluate the role of transvaginal 3D ultrasound in measuring endometrial thickness and volume as predictors of abnormal endometrial pathology in Indian women presenting with perimenopausal AUB. Establishing reliable cut-off values in this population can serve as a practical guideline in low-resource settings, potentially reducing unnecessary invasive procedures.[10]

MATERIALS AND METHODS

This is a prospective observational study conducted in the Department of Obstetrics and Gynecology at a tertiary care center in Dehradun Uttarakhand, over a period of One year.

The study included 60 perimenopausal women presenting with abnormal uterine bleeding (AUB). Perimenopause was defined as the period immediately preceding the menopause, typically marked by irregular menstrual cycles and hormonal fluctuations. Ethical approval for the study was obtained from the Institutional Ethics Committee prior to data collection. Informed consent was obtained from all participants, and confidentiality was strictly maintained.

Inclusion Criteria

- Women aged 40–55 years.
- Presenting with symptoms of AUB (e.g., menorrhagia, polymenorrhea, metrorrhagia, or intermenstrual bleeding).
- Willing to undergo transvaginal 3D ultrasound and endometrial sampling.
- Provided written informed consent.

Exclusion Criteria

- Known cases of pregnancy, pelvic inflammatory disease, or uterine malignancy.
- Patients on hormone replacement therapy.
- Women with bleeding disorders or systemic diseases affecting menstrual patterns.
- Patients who declined consent or follow-up.

Procedure

All eligible participants underwent a detailed history and clinical examination. Baseline investigations including complete blood count and thyroid function tests were performed to rule out systemic causes of AUB.

Each participant then underwent transvaginal ultrasound (TVS) using a high-resolution 3D transvaginal probe. Endometrial thickness was measured in the sagittal plane at the thickest part of the endometrium (double-layer measurement). Endometrial volume was calculated using 3D ultrasound software with the Virtual Organ Computer-aided Analysis (VOCAL) technique, by tracing the endometrial borders in sequential planes.

Following imaging, all patients underwent endometrial sampling by pipelle biopsy or dilation and curettage (D&C), depending on feasibility and clinical indication. The obtained endometrial tissue was sent for histopathological examination (HPE), which served as the gold standard for diagnosing endometrial pathology.

The primary objective was to correlate endometrial thickness and volume with histopathological findings and to determine their sensitivity, specificity, and predictive value in detecting abnormal endometrial pathology (e.g., hyperplasia, atypia, or malignancy).

Statistical Analysis

Data was entered and analyzed using SPSS version 25.0. Descriptive statistics were used to summarize demographic and clinical data. Receiver Operating Characteristic (ROC) curves were generated to determine cut-off values of endometrial thickness and volume for predicting abnormal pathology. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated. A p-value of <0.05 was considered statistically significant.

RESULTS

Table 1 shows the demographic characteristics and medical history of the patients studied. The mean age of the participants was 50.35 ± 4.92 years, with a median of 51 years. The majority of the participants resided in urban areas (60.0%), while 40.0% were from rural backgrounds. This table establishes the basic demographic distribution of the study sample.

Table 2 presents the endometrial thickness and volume measured through transvaginal 3D ultrasound in the study population. The mean endometrial thickness was 8.67 ± 2.954 mm, while the mean endometrial volume was 25.32 ± 8.114 ml. These values provide a quantitative baseline for assessing endometrial pathology.

Table 3 summarizes the final histopathological diagnoses of the patients. Endometrial hyperplasia without atypia was the most common pathology (30.0%), followed by proliferative endometrium (20.0%). Endometrial carcinoma was observed in 13.3% of the cases, emphasizing the need for early detection strategies.

Table 4 compares endometrial thickness and volume between patients with and without malignancy. Patients with malignancy showed significantly higher values for both parameters. The mean endometrial thickness in malignant cases was 21.67 ± 7.512 mm, compared to 9.32 ± 1.874 mm in non-malignant cases ($p < 0.001$). Similarly, endometrial volume was significantly greater in the malignancy group, highlighting their diagnostic relevance.

Table 5 provides a comparative analysis of endometrial thickness and volume across different pathological categories: benign pathology, endometrial hyperplasia, and endometrial carcinoma. Both thickness and volume increased progressively from benign to malignant lesions, with statistically significant differences noted among the groups. These findings support the use of 3D ultrasound as a predictive tool for endometrial pathology severity.

Table 1: Demographic characteristics and medical history of the sample studied

Variable	All Patients (n=60)
Age (years)	
Mean ± SD	50.35 ± 4.920
Median	51.00
Range	41.00, 58.00
IQR	47.00, 54.00
Residence	
Urban	36 (60.0%)
Rural	24 (40.0%)

Table 2: Endometrial thickness (mm) and endometrial volume (ml) in the studied patients

Variable	Mean ± SD	Median	Range	IQR
Endometrial thickness (mm)	8.67 ± 2.954	8.20	3.60, 16.40	6.75, 10.10
Endometrial volume (ml)	25.32 ± 8.114	24.00	11.50, 48.70	19.80, 29.60

Table 3: Final diagnosis by pathological examination in the patients studied

All patients (n=60)	Frequency	Percentage
Proliferative endometrium	12	20.0
Endometrial hyperplasia without atypia	18	30.0
Endometrial hyperplasia with atypia	10	16.7
Endometrial carcinoma	8	13.3
Atrophic endometritis	7	11.7
Irregular endometrial shedding	5	8.3

Table 4: Comparison of endometrial thickness and endometrial volume according to presence of malignancy by pathological examination in the studied patients

	No malignancy (n=44)	Malignancy (n=6)	95% CI	P value
Endometrial thickness (mm)	9.32 ± 1.874	21.67 ± 7.512	-13.45, -7.32	<0.001
Endometrial volume (ml)	17.28 ± 4.203	34.89 ± 9.740	-22.70, -8.45	<0.001

Table 5: Comparison of endometrial thickness and endometrial volume according to endometrial pathology by pathological examination in the patients studied

	Benign endometrial pathology (n=23)	Endometrial hyperplasia (n=21)	Endometrial carcinoma (n=6)	P	P1	P2	P3
Endometrial thickness (mm)	8.75 ± 2.012	12.60 ± 2.220	22.10 ± 7.830	<0.001	0.072	<0.001	<0.001
Endometrial volume (ml)	11.80 ± 2.780	16.90 ± 3.980	35.75 ± 9.640	<0.001	0.088	<0.001	<0.001

DISCUSSION

The present study assessed the role of transvaginal three-dimensional ultrasound in predicting abnormal endometrial pathology in perimenopausal women with abnormal uterine bleeding (AUB) by measuring endometrial thickness and volume. The findings support the diagnostic utility of both parameters, especially in differentiating benign from malignant endometrial conditions.

Our results demonstrated that both endometrial thickness and volume were significantly higher in women with malignant pathology. This aligns with a study by Opolskiene et al., who found that an endometrial thickness threshold of >12 mm was highly predictive of endometrial carcinoma in symptomatic women.[11] Furthermore, the observed increase in endometrial volume among malignant cases supports previous reports that 3D ultrasound provides a more comprehensive evaluation of endometrial architecture, allowing better volume estimation than 2D imaging alone.[12]

Endometrial hyperplasia with atypia also showed elevated thickness and volume compared to benign pathology, highlighting the progressive nature of endometrial changes and reinforcing the importance of early detection. A study by Timmermans et al. emphasized that increased endometrial volume, especially when combined with irregular morphology, significantly raises the suspicion of atypical hyperplasia or malignancy.[13]

Our study is also consistent with evidence from AlHilli et al., who suggested that combining endometrial thickness and volume improves the diagnostic performance for identifying high-risk lesions in women with AUB.[14] This combination could be particularly valuable in low-resource settings, such as many parts of India, where biopsy

access may be limited, and non-invasive triage is essential.

Lastly, the role of endometrial volume as a more stable predictor across various menstrual phases has been discussed by Van den Bosch et al., making it a reliable adjunct in perimenopausal women whose hormonal status fluctuates.[15]

CONCLUSION

Transvaginal three-dimensional ultrasound is a valuable, non-invasive tool in evaluating perimenopausal abnormal uterine bleeding. Endometrial thickness and volume showed significant differences between benign, hyperplastic, and malignant conditions, with both parameters serving as effective predictors of endometrial pathology. These findings support the use of 3D ultrasound as a first-line investigation to guide further histopathological evaluation in resource-limited settings.

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