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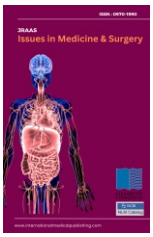

Research Article

Section: Obstetrics & Gynaecology

Role of International Endometrial Tumor Analysis (IETA) Ultrasound Criteria vs Endometrial Thickness in Evaluation of Post Menopausal Bleeding

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HIGHLIGHTS

- IETA improves accuracy
- Thickness lacks specificity
- Histopathology confirms diagnosis
- Vascularity indicates malignancy
- Combined approach beneficial

Key Words:

Postmenopausal bleeding
IETA
Endometrial thickness
Transvaginal ultrasonography
Endometrial carcinoma

ABSTRACT

Introduction: Postmenopausal bleeding is a significant clinical condition requiring prompt evaluation to exclude endometrial malignancy. Endometrial cancer is among the most common gynecological cancers, and early detection is crucial for improving prognosis. Conventional assessment using endometrial thickness lacks specificity, prompting the need for more comprehensive approaches. The International Endometrial Tumor Analysis criteria provide a standardized, multiparametric ultrasound-based evaluation. **Aim & Objective:** This study aimed to compare the diagnostic efficacy of IETA criteria with endometrial thickness using histopathology as the gold standard. **Material & Methods:** A prospective observational study was conducted over 18 months at a tertiary care center, including 62 postmenopausal women presenting with bleeding per vaginum. All participants underwent detailed clinical assessment, transvaginal ultrasonography evaluating endometrial thickness and IETA parameters, followed by histopathological examination through biopsy or hysterectomy. IETA assessment included echogenicity, endo-myometrial junction, midline appearance, intracavitary fluid, and Doppler vascularity. Diagnostic performance was analyzed using sensitivity, specificity, predictive values, and accuracy. **Results:** Among 62 patients, 11 cases were confirmed as endometrial carcinoma. IETA demonstrated higher sensitivity (83.68%) and specificity (39.22%) compared to endometrial thickness (81.82% and 18%, respectively). The overall diagnostic accuracy was greater with IETA (47.6%) than with endometrial thickness (30%). IETA also showed a high negative predictive value (90.92%), indicating reliability in ruling out malignancy. Ultrasound features such as heterogeneous echotexture, irregular endo-myometrial junction, and increased vascularity showed a strong association with malignancy. **Conclusion:** IETA criteria outperform endometrial thickness alone in evaluating postmenopausal bleeding by providing improved sensitivity and diagnostic accuracy. However, both methods have limited specificity and should not be used independently. A combined approach incorporating IETA with histopathological correlation enhances diagnostic reliability and aids in appropriate clinical decision-making.

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INTRODUCTION

Postmenopausal bleeding (PMB) is defined as uterine bleeding occurring after 12 consecutive months of amenorrhea, either spontaneously in women not on hormonal therapy or as abnormal bleeding in those receiving it [1]. It is a significant clinical concern because it may indicate underlying endometrial pathology, ranging from benign conditions to malignancy. Common benign causes include hormonal imbalance, endometrial polyps, leiomyomas, and hyperplasia, yet approximately 10–15% of women with PMB are diagnosed with endometrial carcinoma, while nearly 40% present with polyps. Given this spectrum, PMB requires timely and accurate evaluation to ensure early diagnosis and appropriate management [2,3].

Endometrial cancer (EC) is one of the most common gynecological malignancies, accounting for 20–30% of cancers of the female reproductive system and ranking as the sixth most frequently diagnosed cancer in women globally. It typically affects women between 45 and 65 years of age. It is broadly categorized into estrogen-dependent (type I) and estrogen-independent (type II) tumors, each differing in pathogenesis, clinical behavior, and prognosis. Most cases are low-grade endometrioid adenocarcinomas, often associated with obesity and nulliparity, whereas aggressive variants such as serous and clear cell carcinomas are less common but carry poorer outcomes. Prognosis largely depends on stage and grade; early-stage disease (Stage IA) has a favorable 5-year survival rate exceeding 90%, whereas high-risk disease is associated with metastasis and recurrence. Therefore, early detection is crucial for improving survival outcomes [1,2].

Traditionally, diagnostic approaches for PMB included dilation and curettage and hysteroscopy, with histopathological evaluation considered the gold standard. Although hysteroscopy allows direct visualization and targeted biopsy, both methods are invasive and carry risks such as uterine perforation and infection. Imaging modalities such as magnetic resonance imaging (MRI) can provide a detailed assessment but are limited by cost and accessibility. Consequently, transvaginal ultrasonography (TVS) has emerged as a first-line, non-invasive, and widely available diagnostic tool. Measurement of endometrial thickness (ET) using TVS has been commonly employed, with a threshold of 4 mm often used to exclude malignancy in postmenopausal women. However, reliance on ET alone has limitations, including low specificity and the potential to miss malignancies in cases with thin endometrium [2-4].

To overcome these limitations, more comprehensive ultrasonographic models incorporating grayscale and Doppler features have been developed. These include evaluation of endometrial echogenicity, vascular patterns, and structural characteristics to better differentiate benign from malignant lesions. The International Endometrial Tumor Analysis (IETA) group, established in 2008, standardized terminology and examination protocols for describing endometrial features on ultrasound. The IETA approach emphasizes assessment of parameters such as endometrial morphology, midline appearance, endo-myometrial junction, and vascularity, thereby improving diagnostic accuracy compared to ET measurement alone [1,4,5].

Endometrial pathology is complex and often heterogeneous, involving varied molecular mechanisms & progression patterns

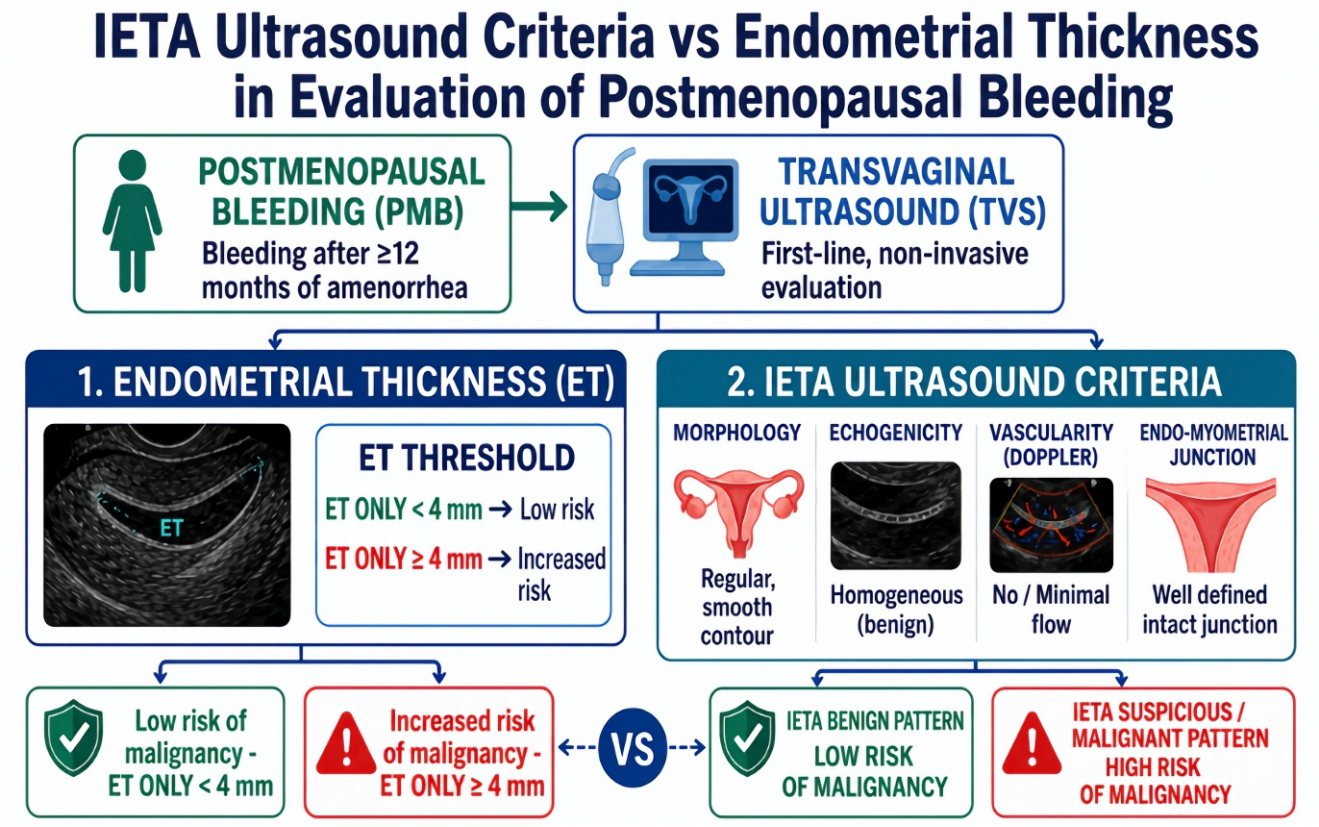

Figure 1: Comparison of endometrial thickness (ET) measurement and IETA ultrasound criteria in the evaluation of postmenopausal bleeding using transvaginal ultrasonography (TVS).

Conditions such as endometrial hyperplasia may regress or progress to malignancy, particularly when atypia is present. Accurate diagnosis increasingly requires integration of imaging findings with histopathology, immunohistochemistry, and molecular testing, especially for high-risk cancers and conditions like Lynch syndrome. In this context, IETA based ultrasonography provides a valuable non-invasive method to identify suspicious features and guide further diagnostic interventions [1].

Given the need for safe, cost-effective, and accurate diagnostic strategies, TVS combined with IETA criteria represents a promising approach for evaluating PMB. It allows early detection, risk stratification, and appropriate selection of patients for invasive procedures such as biopsy or surgery. The development of structured scoring systems based on ultrasound findings further enhances diagnostic consistency and supports clinical decision-making. Overall, improving non-invasive diagnostic accuracy is essential for early identification of malignancy, optimizing treatment, and ultimately enhancing patient outcomes and survival [5,6]. **Figure 1** shows the comparison of endometrial thickness (ET) and IETA ultrasound criteria in evaluating postmenopausal bleeding using TVS.

In this study, our aim is to look for Role of International Endometrial Tumor Analysis (IETA) Ultrasound criteria vs Endometrial thickness in evaluation of Post Menopausal Bleeding by co-relating with Histopathology report (HPR) i.e. Endometrial Biopsy (EB) and post Hysterectomy specimen.

MATERIALS & METHODS

This prospective observational descriptive study was conducted at the Department of Obstetrics and Gynecology, All India Institute of Medical Sciences (AIIMS), Raipur. Ethical approval has been obtained from the Ethical Approval Committee of All India Institute of Medical Sciences (AIIMS), Raipur.

Study Population

All postmenopausal women presenting to the gynecology outpatient department with bleeding per vaginum were included. Postmenopause was defined as no menstruation for at least 12 months in women over 45 without other causes. Eligible participants had bleeding, consented, and underwent transvaginal ultrasound and endometrial biopsy. Excluded were women with known endometrial pathology, cervical carcinoma, prior radiotherapy, chemotherapy, hormone therapy, other malignancies, refusal of biopsy, or loss to follow-up for study inclusion purposes.

Data Analysis

Data were entered and analyzed using SPSS version 22.0. Descriptive statistics including means, medians, standard deviations, and percentages were computed for quantitative and categorical variables. The chi-square test was applied to compare proportions between groups. A p-value of less than 0.05 was considered statistically significant. Receiver operating characteristic curves were generated to assess the discriminative ability of IETA & endometrial thickness, & area under the curve values were calculated for both methods.

RESULTS

The study population comprised women aged 39-82 years with a mean age of 57.84 years and an average BMI of 26.5 kg/m², with most being multiparous (85.5%). Atrophic endometrium was the most common histopathological finding (37%), followed by proliferative endometrium (19.3%) and malignancy (13.6%). Age-wise, atrophic changes predominated above 60 years, while hyperplasia and malignancy were more frequent between 50–60 years. Hypertension (32.2%) and diabetes (24.1%) were the most common comorbidities, although 40.5% had no associated illness. Familial history was largely negative, though hypertension and diabetes were noted. Socioeconomic and demographic factors influenced pathology distribution, with higher malignancy in rural populations and greater hyperplasia in lower socioeconomic groups. Lower educational status correlated with increased atrophic endometrium and hyperplasia, whereas higher education showed varied findings. Housewives formed the majority and had higher rates of atrophic and malignant conditions, while working women showed more diverse patterns. Addiction was associated with increased malignancy, whereas non-addicted individuals predominantly had benign findings. Menstrual patterns also correlated with pathology, with heavy bleeding linked to hyperplasia and malignancy, while regular cycles were associated with benign conditions. Overall, demographic, clinical, and socioeconomic factors significantly influenced the distribution of endometrial pathologies.

Hyper-echoic pattern was the most common (22 cases), followed by uniform 3-layer pattern (5 cases), while iso-echoic, hypo-echoic, and homogeneous regular patterns were less frequent. Irregular and heterogeneous patterns were associated with hyperplasia and malignancy, with a statistically significant relationship between echogenic patterns and endometrial histopathology ($p = 0.001$) **(Figure 2)**. A regular endomyometrial junction pattern was most common (27 cases), while irregular, interrupted, and undefined patterns were less frequent but observed across various histopathologies. Disrupted junction patterns were more associated with hyperplasia, proliferative endometrium, and malignancy, showing a significant correlation with endometrial pathology ($p = 0.002$) **(Table 1)**. A linear midline pattern was most common (31 cases), mainly observed in atrophic and proliferative endometrium, while non-linear, irregular, and undefined patterns were less frequent. These atypical patterns were more associated with hyperplasia and malignancy, indicating a significant correlation between midline pattern and endometrial pathology ($p = 0.001$) **(Figure 3)**. Endometrial synechiae were present in only a few cases (5), mainly in atrophic endometrium and hyperplasia, while most cases (57) showed no synechiae. The presence or absence of synechiae demonstrated a statistically significant association with endometrial pathology ($p = 0.001$) **(Table 2)**.

Most cases showed absence of intra-cavitary fluid (49 cases), while anechoic fluid was seen in 11 cases, mainly in atrophic and proliferative endometrium, with very few cases showing mixed echogenicity (2 cases). Mixed echogenicity was linked to malignancy, and the variation in intra-cavitary fluid patterns showed a significant association with endometrial pathology (p = 0.001) **(Table 3)**. Most cases showed no flow (37 cases), followed by minimal (17 cases) and moderate flow (7 cases), while abundant flow was rare (1 case). Higher flow patterns, especially moderate and abundant flow, were more associated with malignancy, indicating a significant relationship between vascularity and endometrial pathology (p = 0.001).

The analysis of vascular patterns demonstrated that the absence of feeding vessels was the most common finding, observed in 39 cases, predominantly associated with benign conditions such as atrophic and proliferative endometrium. Scattered vessels were the next most frequent pattern (14 cases), also largely linked to non-malignant pathologies. In contrast, single dominant vessels, with or without branching, and vessels of multifocal origin were rare but showed a notable association with malignant and premalignant lesions, including endometrial intraepithelial neoplasia. Circular flow was identified in only one case and was associated with an endometrial polyp, suggesting a benign nature. Overall, increased and abnormal vascularity patterns were significantly correlated with malignancy and hyperplasia, and this association was found to be stat-istically significant (p = 0.001) **(Table 4)**. IETA showed a sensitivity of 83.68% and specificity of 39.22% in detecting endometrial pathology compared to biopsy, with 9 true positives and 20 true negatives.

The positive predictive value was low (23.5%), while the negative predictive value was high (90.92%), giving an overall diagnostic accuracy of 47.6% **(Table 5)**. The diagnostic performance of IETA and endometrial thickness was assessed against biopsy findings in 62 patients. IETA identified most malignant cases with a sensitivity of 83.68%, slightly higher than endometrial thickness at 81.82%, indicating good ability of both methods to detect disease. However, specificity was low, particularly for endometrial thickness (18%) compared to IETA (39.22%), reflecting a high rate of false positives. The positive predictive values were low for both methods, while negative predictive values were relatively high, especially for IETA (90.92%), suggesting better reliability in ruling out malignancy. Overall diagnostic accuracy was modest, with IETA (47.6%) outperforming endometrial thickness (30%). Receiver operating characteristic analysis further demonstrated poor discriminative ability for both methods, with area under the curve values of 0.485 for IETA and 0.419 for endometrial thickness, along with wide confidence intervals and non-significant p-values. These findings indicate that although IETA performs better than endometrial thickness, both methods have limited standalone diagnostic value and should be used alongside histopathological evaluation for accurate diagnosis **(Table 6)**.

Figures 4-6 illustrate the diagnostic performance and ROC curve analyses of IETA (International Endometrial Tumor Analysis) and endometrial thickness (ET). **Figure 4** compares the diagnostic accuracy of IETA and ET, while **Figures 5 and 6** present the ROC curve analyses for biopsy with ET and biopsy with IETA, respectively.

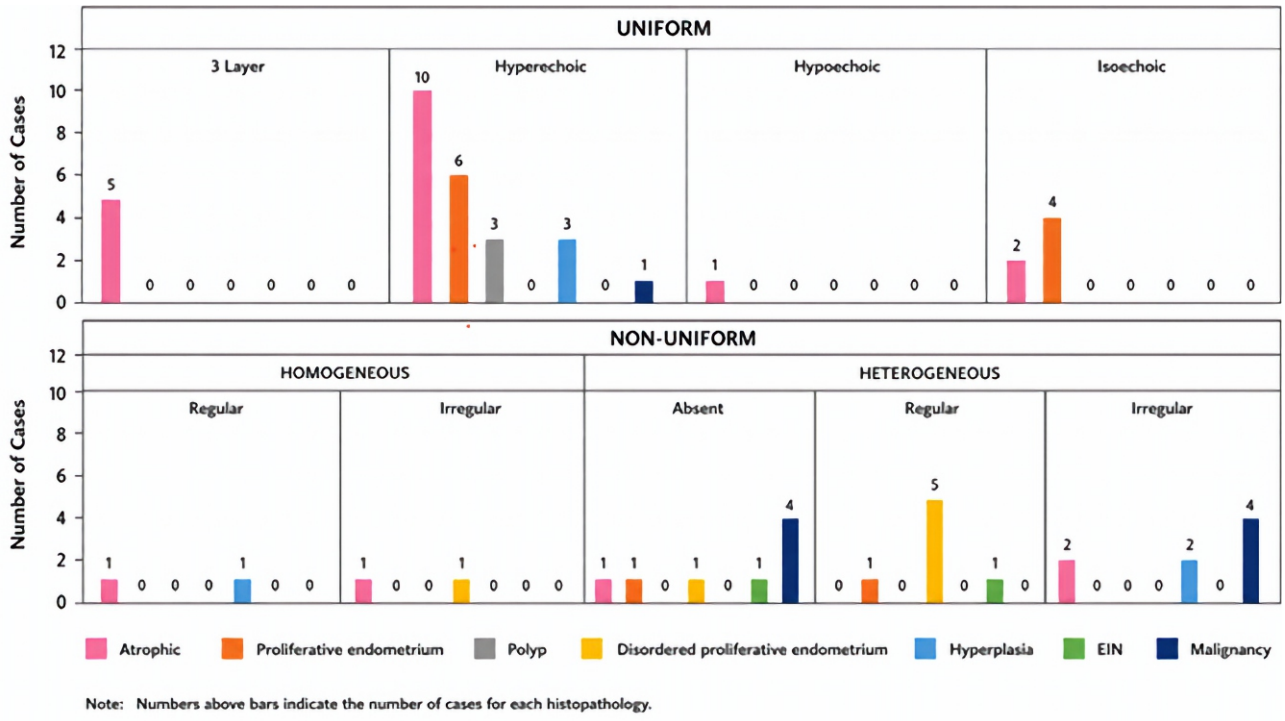

Figure 2: Comparison of the echogenic pattern among the study population based on different histopathologies of the endometrium

Table 1: Comparison of endomyometrial junction patterns among the study population based on different histopathologies of the endometrium

Endo-myometrial junction	Atrophic	Prolifer ative endometrium	Polyp	Disordered prolifera tive endometrium	Hypeplasia	EIN	Malign ancy	Total	p-val ue
Regula r	13	4	2	1	3	1	3	27	0.002 *
Irregular	3	1	0	2	3	0	2	11	
Not defined	2	6	0	1	0	0	2	11	
Interrupted	5	1	1	3	0	1	2	13	

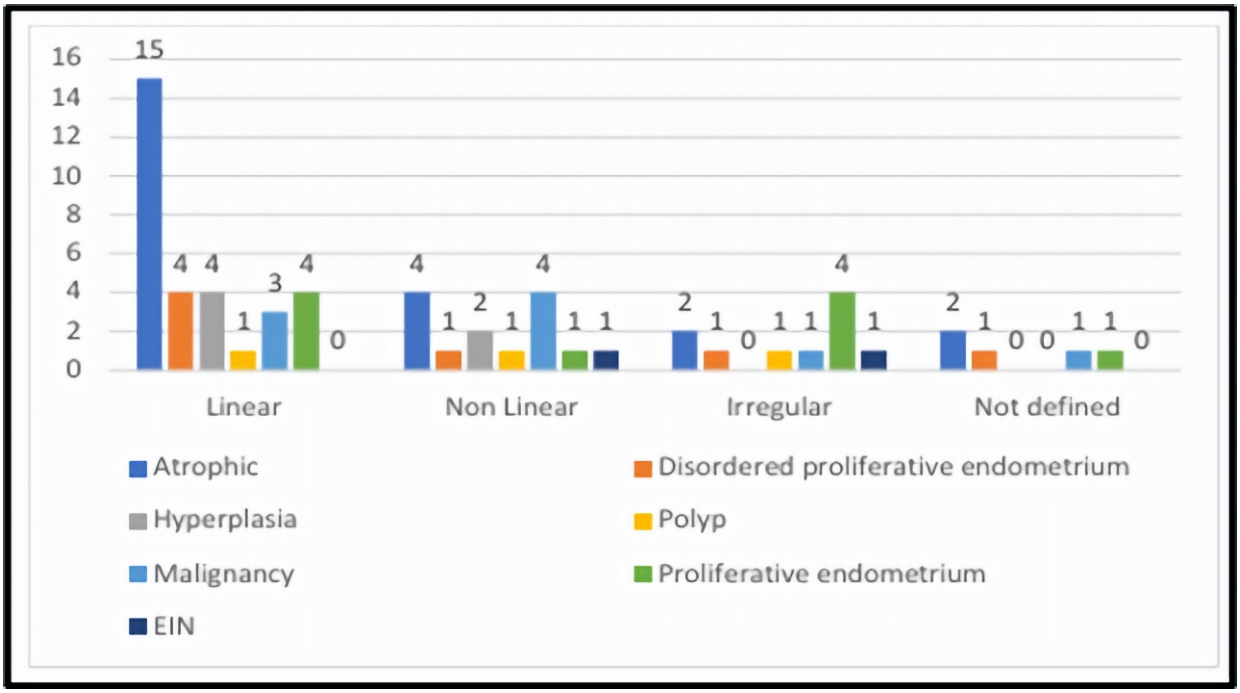

Figure 3: Comparison of midline pattern among the study population based on different histopathologies of the endometrium

Table 2: Comparison of endometrial synechiae pattern among the study population based on different histopathologies of endometrium

Synechiae	Atrophic	Proliferat ive endometrium	Polyp	Disordered proliferat ive endometrium	Hyperplasia	EIN	Maligna ncy	Total	p-valu e
Yes	3	0	0	0	2	0	0	5	0.001*
No	20	12	3	7	4	2	9	57	

Table 3: Comparison of intracavitary fluid pattern among the study population based on different histopathologies of endometrium

			Atrophic	Prolifer ative endometrium	Polyp	Disordered proliferat ive endometrium	Hyperplasia	EIN	Maligna ncy	Total	p-valu e
Intra-cavitary fluid	Absent		15	7	3	7	6	2	9	49	0.001*
	Present	Anechoic	7	4	0	0	0	0	0	11	
		Ground glass	0	0	0	0	0	0	0	0	
		Mixed Echogenicity	1	1	0	0	0	0	0	2	

Table 4: Comparison of flow score among the study population based on different histopathologies of the endometrium

		Atrophic	Proliferative endometrium	Polyp	Disordered proliferative endometrium	Hyperplasia	EIN	Malignancy	Total	p-value
Flow score	No flow	16	8	2	4	5	0	2	37	0.001*
	Minimal flow	7	3	1	2	1	1	2	17	
	Moderate flow	0	0	0	1	0	1	5	7	
	Abundant flow	0	1	0	0	0	0	0	1	

Table 5: Diagnostic performance of IETA (International Endometrial Tumor Analysis) compared with biopsy results

		Biopsy		Total	Validity
		Positive	Negative		
IETA	Positive	9	31	40	Sensitivity = 83.68 %
	Negative	2	20	22	Specificity = 39.22 %
					PPV = 23.50 %
	Total	11	51	62	NPV = 90.92%
					Accuracy = 47.6%

Table 6: Diagnostic performance of ET (Endometrial Thickness) compared with biopsy results

	Biopsy		Total	Validity
	Positive	Negative		
Positive	8	40	48	Sensitivity = 81.82%
Negative	3	11	14	Specificity = 18%
				PPV=18.4 %
Total	11	51	62	NPV= 82.86%
				Accuracy= 30%

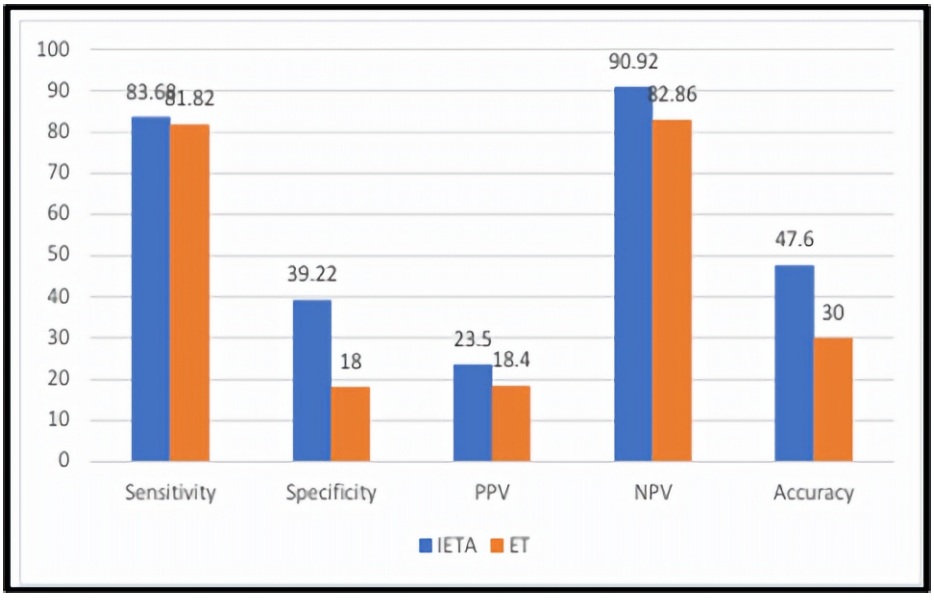

Figure 4: The diagnostic performance of IETA (International Endometrial Tumor Analysis) vs ET (Endometrial Thickness)

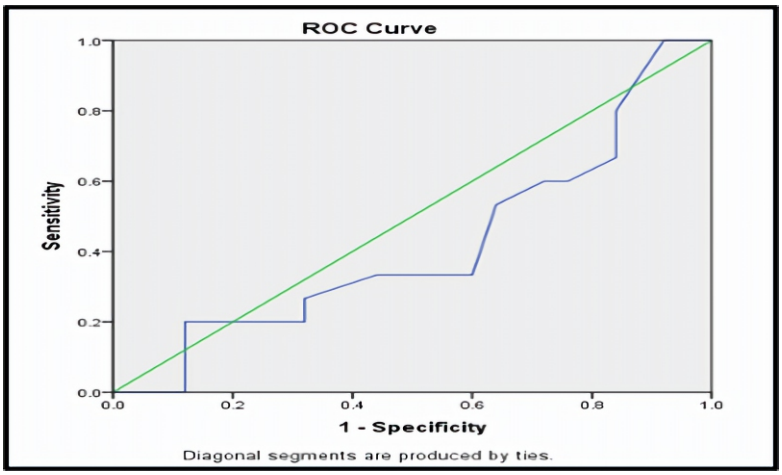

Figure 5: ROC Curve for Biopsy and ET

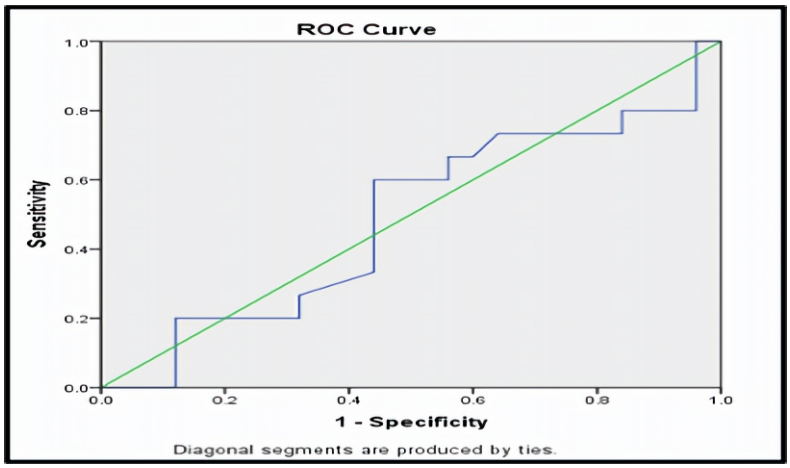

Figure 6: ROC curve for Biopsy and IETA

DISCUSSION

Postmenopausal bleeding (PMB) is defined as uterine bleeding occurring after 12 consecutive months of amenorrhea, either in women not on hormonal therapy or as abnormal bleeding in those receiving it [7]. It is a critical clinical symptom because it may indicate underlying endometrial pathology, including malignancy. Endometrial cancer constitutes 20–30% of gynecological malignancies and is the sixth most common cancer in women globally. Although early-stage disease carries a favorable prognosis with a 5-year survival exceeding 90%, high-risk cases are associated with poor outcomes due to metastasis and recurrence. The disease is broadly classified into estrogen-dependent and independent types, with incidence increasing between 45 and 65 years. Standardized classification systems such as those by FIGO and diagnostic frameworks like the International Endometrial Tumor Analysis (IETA) group have improved evaluation strategies [8].

The demographic profile of the study population aligns with existing literature on postmenopausal women. Participants ranged from 39 to 82 years, with a mean age of 57.84 years, reflecting the typical age group affected by menopausal and postmenopausal conditions [9]. The mean body mass index of 26.5 kg/m² placed most women in the overweight category, consistent with findings from large cohort studies that associate midlife weight gain with metabolic and hormonal changes. High parity was observed in the majority of women, a trend commonly reported in older populations and associated with increased risks of pelvic floor disorders and metabolic conditions [10]. Comorbidities such as hypertension and diabetes were prevalent, though a substantial proportion had no associated illnesses, indicating variability in baseline health status. Familial predisposition was moderate, with hyper-tension and endocrine disorders being the most common, emphasizing the need to consider genetic and metabolic risk factors in evaluation [11]. The distribution of endometrial pathologies demonstrated clear age-related trends. Atrophic endometrium was most common in women above 60 years, while hyperplasia and malignancy were more frequently observed between 50 and 60 years, a critical window for early cancer detection. Histopathologically, atrophic endometrium was the most frequent finding, followed by proliferative endometrium and malignancy, with rarer occurrences of polyps and endometrial intraepithelial neoplasia [12]. Socioeconomic and demographic factors also influenced disease patterns. Lower socioeconomic status was associated with higher rates of hyperplasia and polyps, while malignancy was more frequently observed in rural populations, highlighting disparities in access to healthcare and early diagnosis [13]. Educational status showed a strong correlation, with lower education linked to delayed healthcare access and higher prevalence of pathology, while better-educated women demonstrated more diverse and earlier-detected conditions.

Cultural and occupational factors further influenced health seeking behavior & disease patterns, emphasized the multifactorial nature of endometrial pathology [14].

Ultrasonographic evaluation using IETA criteria revealed significant associations between specific imaging features and histopathological outcomes. Hyperechoic and uniform patterns were commonly linked to benign conditions such as atrophic endometrium, whereas heterogeneous and irregular echotexture was strongly associated with hyperplasia and malignancy [15]. Similarly, disruption of the endo-myometrial junction and irregular or undefined midline patterns were significant predictors of pathological changes. The presence of synechiae, although less frequent, was also significantly associated with underlying pathology [16]. Doppler assessment further enhanced diagnostic accuracy, as increased vascularity and abnormal vessel patterns were strongly correlated with malignancy. **Hooker AB, et. al; 2022** and **Haldorsen IS, et. al; 2014,** highlighted the importance of combining structural and vascular parameters in ultrasound evaluation [17,18].

In this study, IETA positivity was defined by multiple criteria, including increased endometrial thickness (≥4 mm), non-uniform echogenicity, irregular midline and junctional patterns, presence of synechiae or intracavitary fluid, and abnormal Doppler vascularity. Compared to endometrial thickness alone, IETA demonstrated superior diagnostic performance, with higher sensitivity (83.68% vs. 81.82%), specificity (39.22% vs. 18%), and overall accuracy (47.6% vs. 30%). However, both methods showed limited discriminative ability, as reflected by low area under the curve values (0.485 for IETA and 0.419 for ET), indicating that neither should be used as a standalone diagnostic tool [19]. **Lin D, et. al; 2021** and **Chen B, et. al; 2024,** showed that structured IETA assessment improves diagnostic precision by integrating multiple sonographic features rather than relying solely on thickness measurements. While transvaginal ultrasonography remains an effective non-invasive screening tool, its diagnostic value is significantly enhanced when combined with IETA criteria. Overall, a comprehensive approach integrating clinical, sonographic, and histopathological findings is essential for accurate diagnosis, risk stratification, and optimal management of postmenopausal bleeding [2,20].

CONCLUSION

Evaluation of postmenopausal bleeding requires an accurate, non invasive approach to avoid unnecessary procedures while detecting malignancy early. This study shows that IETA criteria applied to transvaginal ultrasonography perform better than using endometrial thickness alone, offering higher sensitivity but lower specificity with modest overall accuracy. IETA identifies structural and vascular abnormalities, including irregular junctions, abnormal vascularity, and heterogeneous echogenicity, often missed by thickness measurement alone. Incorporation of color Doppler improves precision. Sole reliance on endometrial thickness risks false negatives, whereas combining IETA enables better risk stratification and guides decisions regarding biopsy or further management.

LIMITATIONS & FUTURE PERSPECTIVES

The study's limitations include a single centre setting, a relatively small sample size, and a short study duration, which may limit the broader applicability of the results. Future studies should incorporate multicentre designs with larger populations to enhance validity, assess long-term outcomes, and investigate advanced diagnostic & management approaches. Such efforts will improve overall patient care and help minimize complications.

CLINICAL SIGNIFICANCE

The clinical significance of this study lies in its potential to bridge the gap between research findings and practical healthcare applications. It emphasizes the importance of translating scientific observations into meaningful improvements in patient care, diagnosis, and treatment outcomes. By highlighting real-world relevance, the study contributes to evidence based medical practice and supports informed clinical decision making. Ultimately, the findings aim to enhance patient quality of life, optimize therapeutic strategies, and promote better disease management in clinical settings.

ABBREVIATIONS

PMB: Postmenopausal Bleeding
IETA: International Endometrial Tumor Analysis
BMI: Body Mass Index
ET: Endometrial Thickness
TVS: Transvaginal Sonography
EIN: Endometrial Intraepithelial Neoplasia

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AUTHOR CONTRIBUTIONS

All authors significantly contributed to the study conception and design, data acquisition, or data analysis and interpretation. They participated in drafting the manuscript or critically revising it for important intellectual content, consented to its submission to the current journal, provided final approval for the version to be published, and accepted responsibility for all aspects of the work. Additionally, all authors meet the authorship criteria outlined by the International Committee of Medical Journal Editors (ICMJE) guidelines.

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CONFLICT OF INTEREST
Authors declared that there is no conflict of interest.

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All necessary consent & approval was obtained by authors.

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All necessary consent for publication was obtained by authors.

DATA AVAILABILITY
All data generated and analyzed are included within this research article. The datasets utilized and/or analyzed in this study can be obtained from the corresponding author upon a reasonable request.

USE OF ARTIFICIAL INTELLIGENCE (AI) & LARGE LANGUAGE MODEL (LLM)
The authors confirm that no AI & LLM tools were used in thewriting or editing of the manuscript, and no images were altered or manipulated using AI & LLM.

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This article serves as an important educational tool for the scientific community, offering insights that may inspire future research diretions. However, they should not be relied upon independently when making treatment decisions or developing public health policies.

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