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Original Article

Radiology Section

Diagnostic Accuracy of Transabdominal and Transvaginal Ultrasound in Assessing Endometrial Pathologies in Women with Postmenopausal Bleeding: A Cross-sectional Study

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ABSTRACT

Introduction: Postmenopausal Bleeding (PMB) is defined as any spontaneous bleeding occurring after 12 consecutive months of amenorrhoea due to ovarian follicular inactivity. Timely evaluation of PMB is crucial to exclude potential underlying cervical or endometrial malignancies, which are significant causes of mortality. Although endometrial biopsy is considered the gold standard for diagnosis, it is invasive and can be painful. Therefore, a less invasive screening tool is needed, which is where the role of Ultrasound (USG) comes into play to identify candidates for endometrial biopsies.

Aim: To evaluate and compare the diagnostic accuracy of Transabdominal Sonography (TAS) and Transvaginal Ultrasound (TVS) in detecting endometrial pathology in postmenopausal women with bleeding and to compare these findings with endometrial biopsy results.

Materials and Methods: This cross-sectional study, conducted from November 2020 to October 2022 in the Department of Radiodiagnosis at Dr. Pinnamaneni Siddhartha Institute of Medical Sciences and Research Foundation Vijaywada, Andhra Pradesh, India, included 50 adult female patients of menopausal age with atleast 12 months of amenorrhoea. In these patients, endometrial thickness was measured using both TVS and TAS, after which they were referred to the Department of Gynaecology for endometrial biopsy. The patients were divided into two groups: those with endometrial pathology (40 patients) and those with other causes of PMB (10 patients). Quantitative, non normally distributed variables were analysed using the Wilcoxon's Mann-Whitney U Test and the Kruskal-Wallis Test. Receiver Operating Characteristics (ROC) curve analysis with a >5 mm cut-off for endometrial thickness was performed. Statistical significance was set at $p<0.05$.

Results: The mean age of the study participants was 59±7 years and the endometrial thickness measured using TAS was 4.46±3.05 mm, while the endometrial thickness measured using TVS was 5.28±3.83 mm. Significant differences were observed between the two groups (patients with and without endometrial pathology as a cause for PMB) regarding endometrial thickness, as measured by both TAS ($W=446.000$, $p<0.001$) and TVS ($W=442.000$, $p<0.001$). The endometrial pathologies identified in the study included endometrial atrophy (26 patients), endometrial hyperplasia (4 patients), endometrial carcinoma (7 patients), and endometrial polyps (3 patients). The strength of association, measured by Point-Biserial Correlation, was 0.69 for TAS and 0.70 for TVS, indicating a large effect size in both cases. Endometrial pathology was predicted with a sensitivity of 77% and specificity of 95% using TAS, and with a sensitivity of 85% and specificity of 89% using TVS.

Conclusion: The present study emphasises that PMB is a prevalent concern in gynaecological practice, and ruling out endometrial cancer is critical due to its associated mortality. TVS remains a primary tool for identifying patients who require further evaluation through endometrial biopsy. Although TAS is initially performed for screening other pelvic pathologies and prior to conducting TVS, both modalities should be utilised.

Keywords: Endometrial atrophy, Endometrial carcinoma, Sensitivity, Specificity

INTRODUCTION

Postmenopausal Bleeding (PMB) is defined as any spontaneous bleeding occurring after a woman has attained menopause, characterised by the absence of menstrual cycles for 12 consecutive months due to the failure of ovarian follicular activity [1]. Vaginal bleeding occurs in upto 10% of postmenopausal women and accounts for around two-thirds of all gynaecologic office visits in this population [2]. However, the incidence of PMB may decline with age. At the onset of menopause, roughly 40% of women experience bleeding each year; however, three years after menopause, PMB falls to 4% per year [3]. This decline underscores the importance of monitoring and evaluating PMB due to its association with potential endometrial pathology. Among these pathologies, endometrial carcinoma is the most severe, given its potential for mortality. In India, the Age Standardised Mortality Rate (ASMR) for endometrial cancer is 0.96 per 100,000 women. This indicates that, after adjusting for age differences in the population, approximately 0.96 women out of every 100,000 die from endometrial cancer each year [4].

Pelvic ultrasonography is usually the first investigation for PMB. TAS is typically ordered first because it is less invasive and can image other pathologies in the pelvis and abdomen; however, it has a limited ability to visualise female pelvic organs, especially when they are atrophied [5]. TVS, although more invasive than TAS, offers better resolution for imaging the uterus and adnexa [6]. TAS can also be used to differentiate PMB from other causes, such as bleeding from the urinary tract or gastrointestinal system, although its sensitivity for detecting these

lesions is limited. Endometrial biopsy is currently considered the gold standard for diagnosing endometrial pathology [7]. However, because it is invasive, requires a gynaecologist to perform the procedure safely, and sample processing takes time, endometrial biopsy is impractical as a first-line screening method for all patients with PMB.

This highlights the need for a screening method to identify patients for endometrial biopsy. Although studies comparing the function of ultrasonography with endometrial pathology have been conducted over several years ago, there is a lack of recent research utilising the latest generation USG machines and the increased expertise of sonologists, particularly in the context of India [8].

The study aimed to compare transabdominal and transvaginal ultrasonography in detecting endometrial pathologies among postmenopausal women with bleeding.

MATERIALS AND METHODS

The present cross-sectional study was conducted from November 2020 to October 2022 in the Department of Radiodiagnosis at Dr. Pinnamaneni Siddhartha Institute of Medical Sciences and Research Foundation, Vijaywada, Andhra Pradesh, India. Ethical approval for the study was obtained from the Institutional Review Board (IRB), with IEC approval number PG/636/20. The study included 50 adult female patients of menopausal age (average age 59±7 years) who had experienced atleast 12 months of amenorrhoea.

Inclusion criteria: Female patients in the menopausal age group (45 years and older) who have experienced atleast 12 months of amenorrhoea.

Exclusion criteria:

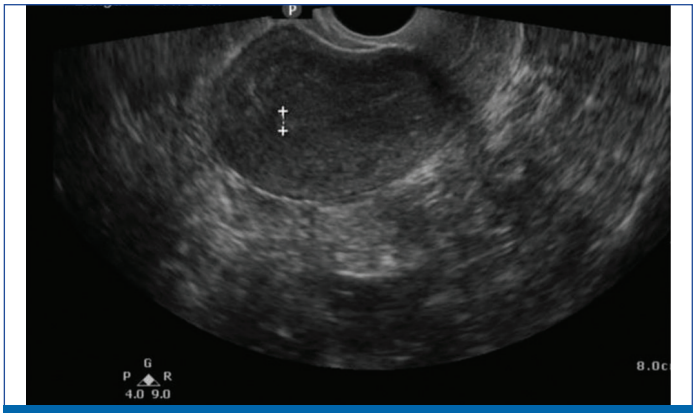
- Women in the reproductive age group;
- Postmenopausal women on hormone replacement therapy;
- Women with previously diagnosed gynaecological conditions presenting with PMB;
- Women with coagulopathy or bleeding disorders;
- Women using antiplatelet agents or anticoagulants;
- Women with a history of any trauma;
- Women who did not consent to any of the study procedures.

Sample size: A sample size of 50 patients was determined based on preliminary data and available resources. In the present department, fewer than 5% of patients with PMB undergo both invasive procedures, such as TVS and endometrial biopsy. Given this low prevalence, authors concluded that a sample size of 50 would provide sufficient cases to achieve meaningful results and ensure the robustness of our analysis within the constraints of available patient data.

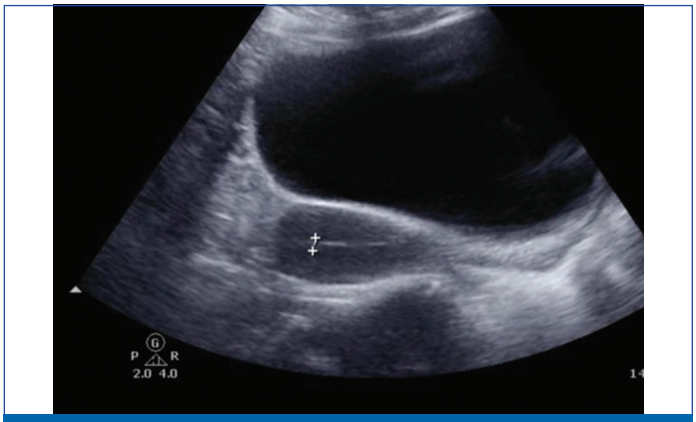
Study Procedure

In present study, endometrial measurements were performed in the longitudinal or sagittal plane using TVS and TAS. TVS [Table/Fig-1] is an internal USG method used for indirect visualisation of the endometrium. In contrast, TAS involves scanning through the lower abdomen to evaluate the female pelvic organs [Table/Fig-2]. The assessment involved measuring the thickest echogenic region, extending from one basal endometrial interface across the endometrial canal to the opposing basal surface. The measurement aimed to include the complete endometrial lining upto the endocervical canal while carefully excluding the hypoechoic myometrium and any intrauterine fluid to ensure precision.

Measurements were taken multiple times and averaged to ensure accuracy, with all procedures performed by a single radiologist with 10 years of experience using a standardised protocol. The data analysed included endometrial thickness measurements recorded from TAS and TVS. Measurements were compared between patients with endometrial pathology and those without. Additionally, endometrial thickness (in mm) was compared across eight subgroups based on the variable Histopathological Examination (HPE).



[Table/Fig-1]: Measurement of endometrial thickness using Transvaginal Ultrasound (TVS).



[Table/Fig-2]: Measurement of endometrial thickness using Transabdominal Ultrasound (TAS).

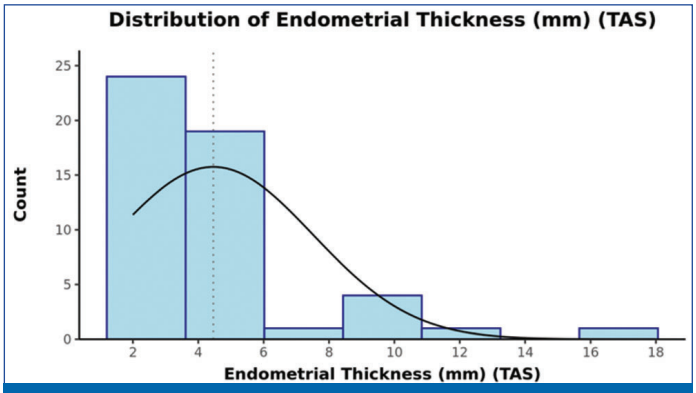
STATISTICAL ANALYSIS

Endometrial thickness measurements obtained through both transabdominal and TVS were recorded in an MS Excel spreadsheet. The data were analysed using the Statistical Package for Social Sciences (SPSS) version 21.0. The Wilcoxon's Mann-Whitney U Test was applied to compare endometrial thickness measurements between patients with and without endometrial pathology for both TAS and TVS. ROC curve Analysis was utilised to assess the diagnostic performance of endometrial thickness measurements from TAS and TVS in predicting endometrial pathology. The Kruskal-Wallis test was applied to compare the eight subgroups of histopathological examination (HPE) based on endometrial thickness (mm).

RESULTS

The mean±Standard Deviation (SD) age of the patients was 59±7 years, with a median Interquantile Range age of 59.00 (54-68) years. Their ages ranged from 48 to 74 years. Notably, 26 patients (52%) fell within the age group of 51-60 years, indicating that most cases of PMB occurred in the first decade after menopause.

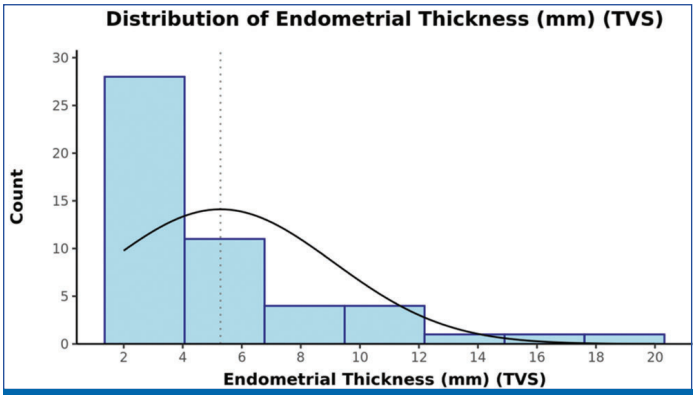
The mean±SD endometrial thickness (TAS) was 4.46±3.05 mm [Table/Fig-3].



[Table/Fig-3]: Distribution of endometrial thickness by TAS.

The mean±SD of endometrial thickness (TVS) was 5.28±3.83 mm [Table/Fig-4].

Regarding endometrial pathology, 10 patients 20% had no endometrial pathology, while 40 patients (80%) had endometrial pathology. The endometrial pathologies included in the study are endometrial atrophy, endometrial hyperplasia, endometrial carcinoma, and endometrial polyps [Table/Fig-5].



[Table/Fig-4]: Distribution of endometrial thickness by TVS.

HPE	n (%)	95% CI
EA	26 (52)	37.6%-66.1%
ECA	7 (14)	6.3%-27.4%
Ca cervix	6 (12)	5.0%-25.0%
EH	4 (8)	2.6%-20.1%
EP	3 (6)	1.6%-17.5%
Cervicitis	2 (4)	0.7%-14.9%
Fibroid	1 (2)	0.1%-12.0%
Ovarian cyst	1 (2)	0.1%-12.0%

[Table/Fig-5]: Distribution of the participants in terms of HPE (N=50).
EA: Endometrial atrophy; ECA: Endometrial carcinoma; CA cervix: Carcinoma cervix; EH: Endometrial hyperplasia; EP: Endometrial polyp

There was a significant difference between the two groups in terms of Endometrial Thickness (mm) (TAS) (W=446.000, p<0.001), with the mean Endometrial Thickness (mm) (TAS) being highest in the group with endometrial pathology. The strength of the association (Point-Biserial Correlation) was 0.69, indicating a large effect size [Table/Fig-6].

Endometrial thickness (mm) (TAS)	Endometrial pathology		Wilcoxon's Mann-Whitney U test	
	Present	Absent	W	p-value
Mean±SD	8±3.94	3.22±1.18	446.000	<0.001
Median (IQR)	7 (6-9)	3 (2-4)		
Range	3-18	2-6		

[Table/Fig-6]: Comparison of the 2 subgroups of the variable endometrial pathology in terms of endometrial thickness (mm) (TAS).

There was a significant difference between the two groups in terms of endometrial thickness (mm) measured by TVS (W=442.000, p<0.001), with the median endometrial thickness being highest in the "Endometrial Pathology: Present" group. The strength of association, measured by the point-biserial correlation, was 0.7, indicating a large effect size [Table/Fig-7].

There was a significant difference among the eight groups in terms of Endotracheal Thickness (ET) (mm) (TAS) (χ^2=27.846, p<0.001), with the median ET (mm) (TAS) being highest in the HPE: ECA group. The strength of association (Kendall's Tau) was 0.11, indicating a small effect size [Table/Fig-8].

There was a significant difference among the eight groups in terms of ET measured in millimeters (mm) via TVS (χ^2=30.608, p<0.001). The median endometrial thickness (mm) measured by TVS was highest in the HPE: ECA group. The strength of association, as measured by Kendall's Tau, was 0.12, indicating a small effect size [Table/Fig-9].

Endometrial thickness (mm) (TVS)	Endometrial pathology		Wilcoxon's Mann-Whitney U test	
	Present	Absent	W	p-value
Mean±SD	9.77 (4.68)	3.70 (1.68)	442.000	<0.001
Median (IQR)	9 (6-12)	3 (3-5)		
Range	3-20	2-10		

[Table/Fig-7]: Comparison of the 2 subgroups of the variable endometrial pathology in terms of endometrial thickness (mm) (TVS) (n=50)

The odds ratio (95% CI) for endometrial pathology: present when endometrial thickness (mm) (TAS) is ≥6 was 86.54 (4.39-1706.08). The relative risk (95% CI) for endometrial pathology: present when endometrial thickness (mm) (TAS) is ≥6 was 7.17 (3.54-15.25).

The odds ratio (95% CI) for endometrial pathology: present when endometrial thickness (mm) (TVS) is ≥6 was 39.37 (6.2-250.09). The relative risk (95% CI) for endometrial pathology: present when endometrial thickness (mm) (TVS) is ≥6 was 7.98 (3.18-20.74).

The sensitivity and specificity of TAS were 77% and 95%, respectively, while TVS demonstrated a sensitivity of 85% and a specificity of 89% [Table/Fig-10-12].

DISCUSSION

The primary objective of present study was to evaluate and compare the diagnostic accuracy of TAS and TVS in detecting endometrial pathology in postmenopausal women with bleeding, using endometrial biopsy as the gold standard. The present findings revealed that TVS demonstrated a stronger association with histopathological examination compared to TAS, suggesting that TVS may be a more effective method for diagnosing endometrial abnormalities in present patient population.

The TAS offers a broader view of the pelvis compared to the detailed images provided by TVS. It is particularly useful for examining large pelvic masses that extend into the abdomen, which may not be as effectively visualised with TVS [9]. Bree LE, highlighted that many sonologists prefer performing TAS as a screening procedure before employing other USG techniques, such as TVS or Hysterosalpinogram (HSG) [10].

Out of the participants, 33 (66.0%) had TAS findings that correlated with HPE, while 17 (34.0%) had TAS findings that did not correlate with HPE. For TVS, 38 (76.0%) had results that correlated with HPE, whereas 12 (24.0%) had TVS findings that did not correlate with HPE. Regarding endometrial pathology, 10 (20.0%) had no endometrial pathology, while 40 (80.0%) had endometrial pathology. The endometrial pathologies included in the study were endometrial atrophy, endometrial hyperplasia, endometrial carcinoma, and endometrial polyps.

The present study revealed that the sensitivity and specificity of TAS were 77% and 95%, respectively, while TVS showed a sensitivity of 85% and specificity of 89%. These findings are consistent with existing literature, which often highlights the superiority of TVS over TAS for detecting endometrial abnormalities. For instance, Tsuda H et al., found that TVS had a sensitivity and specificity of 100% and 54.1%, respectively, compared to 83.3% and 58.8% for TAS [11]. However, Sadeq MG, reported that TAS had a sensitivity of 100% and specificity of 68.4%, whereas TVS exhibited a sensitivity of 100% and specificity of 94.7%, indicating that TVS not only has better sensitivity but also higher specificity when compared to TAS [12].

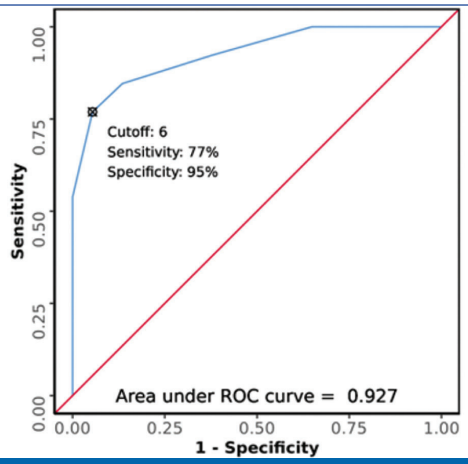
In a study conducted by Muhammad PR et al., both TVS and TAS were found to be highly sensitive in detecting endometrial hyperplasia [12]. However, TVS proved to be more sensitive and

Endometrial thickness (mm) (TAS)	HPE								Kruskal-wallis test	
	EA	ECA	Ca cervix	EH	EP	Cervicitis	Fibroid	Ovarian cyst	χ^2	p-value
Mean±SD	3.46±1.24	9.43±4.61	2.17±0.41	7.00±2.45	4.67±1.53	2.50±0.71	3.00±NA	4.00±NA	27.846	<0.001
Median (IQR)	3 (2.25-4)	9 (6.5-11)	2 (2-2)	7.5 (5.5-9)	5 (4-5.5)	2.5 (2.25-2.75)	3 (3-3)	4 (4-4)		
Range	2-6	4-18	2-3	4-9	3-6	2-3	3-3	4-4		

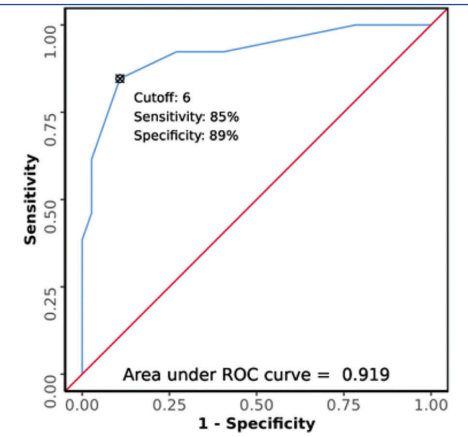
[Table/Fig-8]: Comparison of the 8 subgroups of the Variable HPE in Terms of Endometrial Thickness (mm) (TAS) (N=50).

Endometrial thickness (mm) (TVS)	HPE								Kruskal-wallis test	
	EA	ECA	Ca cervix	EH	EP	Cervicitis	Fibroid	Ovarian cyst	χ^2	p-value
Mean±SD	3.85 (1.38)	11.71 (5.15)	2.33 (0.52)	10.00 (0.82)	5.00 (1.73)	3.00 (0.00)	3.00 (NA)	4.00 (NA)	30.608	<0.001
Median (IQR)	3.5 (3-5)	12 (8-14.5)	2 (2-2.75)	10 (9.75-10.25)	6 (4.5-6)	3 (3-3)	3 (3-3)	4 (4-4)		
Range	2-7	5-20	2-3	9-11	3-6	3-3	3-3	4-4		

[Table/Fig-9]: Comparison of the 8 subgroups of the variable HPE in terms of endometrial thickness (mm) (TVS).



[Table/Fig-10]: ROC curve analysis showing diagnostic performance of endometrial thickness (mm) (TAS) in predicting endometrial pathology: present vs endometrial pathology: absent (n=50).



[Table/Fig-11]: ROC curve analysis showing diagnostic performance of endometrial thickness (mm) (TVS) in predicting endometrial pathology: present vs endometrial pathology: absent (N=50).

Predictor	AUROC	95% CI	P	Sn	Sp	PPV	NPV	DA
Endometrial thickness (mm) (TAS)	0.927	0.84-1	<0.001	77%	95%	83%	92%	90%
Endometrial thickness (mm) (TVS)	0.919	0.823-1	<0.001	85%	89%	73%	94%	88%

[Table/Fig-12]: Table comparing TAS and TVS in diagnostic parameters.
AUROC: Area under ROC curve; CI: Confidence interval; P: p-value; Sn: Sensitivity; Sp: Specificity; PPV: Positive predictive value; NPV: Negative predictive value; DA: Diagnostic Accuracy.

specific in detecting focal masses or polyps within the endometrial cavity due to its ability to produce clearer and better images, as the USG probe is closer to internal structures. Therefore, Muhammad PR et al., concluded that TVS scanning is an excellent tool for determining whether curettage or endometrial biopsy is necessary [12].

Differences in mean endometrial thickness measurements between TAS and TVS were larger in patients with a retroflexed uterus compared to those with an anteflexed uterus, as noted by Tsuda H et al., [11]. This suggests that TVS is particularly advantageous in cases where uterine positioning complicates imaging. Furthermore, Nasri MN et al., noted that TVS missed bladder wall carcinoma in a patient with an inactive endometrium, whereas TAS successfully detected a thickened bladder wall in the same patient [13]. Conversely, TVS demonstrated better sensitivity in detecting the endometrium when multiple fibroids or large sarcomas distorted the uterus, making it difficult to outline the endometrium on TAS.

Patient compliance and acceptance of TVS were high, likely because it eliminates the need for a full bladder. Additionally, artifacts due to obesity were not problematic with TVS. However, a full bladder allowed for better detection of bladder pathologies using TAS. Nasri MN et al., also stated that the endomyometrial junction was clearer on TVS than on TAS, and in cases of uterine prolapse, TVS provided better imaging regardless of the uterus's position [13].

In the study by Natarajan P, TAS was identified as the first choice for initial imaging, particularly for patients without prior evaluations [14]. TAS provides a comprehensive panoramic view, enabling a thorough assessment of the entire lesion and its relationship with surrounding organs. However, TVS, with its superior resolution, offers a more detailed evaluation of lesion morphology. The study emphasised that TVS outperforms TAS in accurately measuring endometrial thickness and significantly enhances the diagnosis of pelvic pathologies.

In the study by Singh A et al., TAS was recommended as the initial imaging modality, especially for patients who had not undergone previous imaging [15]. TAS provides a broad view of the pelvic area, assisting in the assessment of the entire lesion and its relationship with adjacent organs. However, TAS has limitations, particularly in examining obese patients, those unable to fill their bladder, and women with a retroverted uterus, where the fundus may be outside the transducer's focal zone.

The TVS, on the other hand, offers superior resolution and is regarded as the gold standard non invasive tool. Although TVS has a limited field of view, it provides detailed morphological information about lesions. The study concluded that both TAS and TVS are effective in measuring endometrial thickness and have high sensitivity and accuracy in diagnosing pelvic pathologies.

It was conducted with rigorous statistical analysis and appropriate tests of significance. There was no interobserver variability, as all USGs were performed by the same radiologist. Histopathological findings were reported in a standardised manner.

Limitation(s)

The small sample size may limit the generalisability of the results, and the consecutive sampling method might impact the

representativeness of the sample. Additionally, a key limitation of present study is that the sensitivity and specificity of individual lesions were not assessed using transabdominal and TVS.

CONCLUSION(S)

TVS remains a valuable screening tool due to its high sensitivity, enabling clinicians to identify patients who need further evaluation through endometrial biopsy. This approach aids in informed decision-making regarding further evaluation and management. While TAS is typically performed first to screen for other pelvic pathologies, both modalities should be used in conjunction to ensure a comprehensive assessment.

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