The Egyptian Journal of Hospital Medicine (July 2025) Vol. 100, Page 4149-4154

# Evaluation of the Uterine Cavity by 3 D Ultrasonography in Perimenopausal Bleeding in Comparison with Hysteroscopy

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## ABSTRACT

**Background:** Abnormal uterine bleeding (AUB) in perimenopausal women is a frequent but often ambiguously characterized condition that necessitates precise diagnosis. While hysteroscopy remains the definitive method for assessing intrauterine abnormalities, three-dimensional ultrasonography (3D US) has gained attention as a less invasive diagnostic option.

**Subjects and Methods:** A cross-sectional study was conducted at Suez Hospital, Egypt, and Ain Shams Obstetrics and Gynecology Hospital, Cairo, Egypt. One hundred perimenopausal women presenting with AUB were recruited from the outpatient clinic.

**Results:** A significant difference was observed between 3D US and hysteroscopic findings ($p = 0.018$). The sensitivity, specificity, positive predictive value, and negative predictive value of 3D US in diagnosing intrauterine abnormalities were 89%, 54%, 66.4%, and 82.5%, respectively.

**Conclusions:** Three-dimensional ultrasound serves as a useful diagnostic modality for detecting intrauterine abnormalities in perimenopausal abnormal uterine bleeding. However, cases with negative ultrasound findings warrant confirmation through hysteroscopy, which continues to be the gold standard for precise diagnosis and management of intrauterine lesions.

**Keywords:**3D Ultrasonography, Hysteroscopy, Perimenopausal bleeding.

## INTRODUCTION

Changes in menstrual blood volume are a common symptom during the perimenopausal period and often reflect underlying gynecological disorders [1].

The causes of perimenopausal bleeding are diverse, encompassing hormonal disturbances, endometrial polyps, malignancies, adenomyosis, vascular anomalies, and systemic medical conditions [2]. Assessment of uterine pathology can be performed using both invasive and non-invasive diagnostic techniques. Non-invasive methods are generally preferred due to their safety profile, cost-effectiveness, and ease of application [3].

Ultrasonography stands out as a dependable, non-invasive imaging modality widely used as an initial diagnostic tool before resorting to invasive procedures like hysteroscopy [4].

Among invasive approaches, hysteroscopy remains the gold standard for direct examination of the uterine cavity. It allows for precise identification of intrauterine abnormalities and facilitates accurate diagnosis as well as tailored treatment planning [5].

Compared to other imaging techniques such as hysterosalpingography, hysteroscopy offers superior diagnostic accuracy and therapeutic benefits [4].

Non-invasive imaging methods, including transabdominal ultrasound (TAS) and two-dimensional transvaginal sonography (2D-TVS), are commonly employed in the evaluation of abnormal uterine bleeding (AUB). These techniques are effective in detecting uterine lesions like fibroids, polyps, and localized abnormalities, and also enable assessment of adnexal structures [6].

Three-dimensional ultrasonography (3D-US) advances these diagnostic capabilities by providing volumetric data and multiplanar reconstructions, thereby enhancing visualization of the endometrial cavity and allowing a more comprehensive evaluation of uterine morphology [7].

Three-dimensional transvaginal sonography (3D-TVS) is recognized as a cost-efficient, non-invasive, and highly effective approach for the indirect visualization of the endometrial cavity. Due to its accessibility and diagnostic performance, 3D-TVS is recommended as a frontline imaging technique for assessing uterine lesions in reproductive-aged women presenting with abnormal uterine bleeding [8].

Despite progress in imaging technology, uncertainty remains regarding the optimal application of 3D-TVS as a sole diagnostic tool for intrauterine pathologies. While hysteroscopy continues to be the definitive standard, further studies are warranted to better establish the sensitivity and specificity of 3D-TVS in distinguishing



Received: 24/04/2025
Accepted: 23/06/2025

benign from malignant lesions, thereby potentially minimizing unnecessary invasive procedures.

The aim of this study was to assess the diagnostic accuracy of 3D ultrasound in identifying uterine causes of perimenopausal bleeding, compared to hysteroscopy.

## SUBJECTS AND METHODS

### Study area

This cross-sectional study was conducted at two tertiary care centers: Suez Hospital in Suez and Ain Shams Obstetrics and Gynecology Hospital in Cairo, Egypt. The initial phase took place in the gynecology outpatient clinic at Suez Hospital, where baseline information was collected, including demographics, obstetric and medical history, body mass index (BMI) at the first visit, complete blood count, liver and kidney function tests, total bilirubin, and prothrombin time (PT). Following this, patients were referred to Ain Shams Hospital for three-dimensional (3D) ultrasound and hysteroscopic evaluation.

### Study Outcomes

The primary objective was to assess the diagnostic accuracy of 3D ultrasound in identifying uterine causes of perimenopausal bleeding, using hysteroscopy as the reference standard.

### Sample Size and Patient Evaluation

A total of 100 patients were enrolled. Comprehensive histories were documented, covering personal, medical, surgical, and family backgrounds. Particular emphasis was placed on the characteristics of abnormal uterine bleeding, including onset, duration, progression, possible etiologies, complications, and previous evaluations or treatments.

### Physical and Laboratory Assessment

Patients underwent thorough clinical examinations, including general physical, abdominal, and pelvic assessments. Laboratory investigations included routine tests such as complete blood count (CBC), blood glucose, renal and liver function tests, thyroid profiles, and coagulation screening to support diagnosis.

### Imaging Procedures

The imaging protocol began with conventional two-dimensional (2D) ultrasound, followed by 3D ultrasound using the Voluson 730 Pro V system (General Electric, CA, USA). This system was equipped with an AB2-7 wide-band convex endocavitary volume probe (3.7-9.3 MHz) and an RAB4-BL wide-band convex volume probe (4-8.5 MHz) for comprehensive volumetric assessment.

### Hysteroscopy Technique

Hysteroscopy was performed promptly after bleeding cessation using an office hysteroscope with a 2.8 mm diameter, without anesthesia. Distilled water was used as the distension medium to allow optimal visualization of the uterine cavity.

### Biopsy and Histopathological Analysis

Targeted biopsy samples were obtained under hysteroscopic guidance from localized endometrial lesions. In cases where hysteroscopy revealed no visible pathology, samples were taken via conventional dilation and curettage (D&C) under general anesthesia. All tissue specimens were then submitted for histopathological examination to exclude malignancy.

**Calculation of sample size:** Sample size was calculated using PASS 15 based on findings from a previous study [9], which reported fibroids as the most common lesion among women with abnormal uterine bleeding (prevalence 32%) and a 3D-ultrasound sensitivity and specificity of 67% and 54%, respectively. We performed two-sided binomial tests to estimate the number of patients required to detect clinically meaningful changes in diagnostic accuracy. Assuming a disease prevalence of 32%, an increase in sensitivity from 0.50 to 0.67 would require approximately 100 patients to achieve 90% power with a two-sided significance level of $\alpha = 0.05$. For specificity, an increase from 0.50 to 0.54 would be detectable with approximately 50% power using the same test parameters. Therefore, a sample size of **100 patients** was chosen to ensure adequate power for the primary sensitivity endpoint while providing reasonable precision for specificity estimates.

### Data management and analysis:

A statistical analysis of the agreement between 3D ultrasound and hysteroscopy in 100 patients, assessed using McNemar's test, revealed a statistically significant difference in the discordant pairs ($p = 0.018$). When using hysteroscopy as the reference standard, 3D ultrasound demonstrated a sensitivity of 89.0% for detecting intrauterine lesions, correctly identifying most true cases, but a specificity of 54.0%, indicating a moderate rate of false-positive findings. The positive and negative predictive values were 66.4% and 82.5%, respectively, suggesting that a negative result on 3D ultrasound is a reliable indicator of the absence of a lesion.

### Ethical considerations:

**Ethical considerations were carefully addressed in this study. Approval was obtained from the Ethical Committees of Faculty of Medicine, Suez University (53/2025) before the study commenced. Informed consent was taken from all participants after explaining the study's purpose, procedures, potential risks, and benefits. Patients were assured of their right to withdraw at any time without affecting their medical care. Confidentiality of all collected data was maintained, and personal information was**

**anonymized to protect participants' privacy. The study was conducted following the ethical guidelines of the Declaration of Helsinki.**

## RESULTS

The baseline demographic and clinical characteristics of the 100 enrolled patients are summarized in Table 1. The study cohort had a mean age of 46.2 ± 2.7 years, with an age range from 40 to 50 years, indicating a focus on a perimenopausal patient population. The mean parity was 4.5 ± 1.3, reflecting a multigravid population with a range of 2 to 7 previous births. The mean Body Mass Index (BMI) was 30.83 ± 2.32 kg/m², which places the average participant in the obese class I category according to WHO classification, suggesting obesity may be a significant characteristic of the study group.

Regarding residence, the majority of participants (60%, n=60) were from urban areas, while 40% (n=40) were from rural settings. A significant majority of the patients were educated (83%, n=83), with only a small proportion being non-educated (17%, n=17). This demographic profile establishes that the study population primarily consisted of obese, multigravid, perimenopausal, educated women residing in urban areas. These characteristics are crucial for interpreting the study's findings and for assessing the generalizability of the results to similar patient demographics.

**Table 1: Demographic characteristics of the studied patients (n = 100)**

| Characteristics | Mean ± SD (Range) | |
|---|---|---|
| **Age in years** | 46.2 ± 2.7 (40-50) | |
| **Parity** | 4.5 ± 1.3 (2-7) | |
| **BMI** | 30.83 ± 2.32 | |
| **Residence** | rural | 40%(n=40) |
| | urban | 60%(n=60) |
| **education** | educated | 83%(n=83) |
| | Non-educated | 17%(n=17) |

The clinical presentation of the studied group is shown in table 2. The most common presentation was **menorrhagia** in **37 patients (37%)**, followed by metrorrhagia in 28 (28%) and polymenorrhagia in 20 (20%).

**Table 2: Clinical presentation of the studied patients (n = 100)**

| Clinical presentation | N | % |
|---|---|---|
| Heavy menstrual bleeding | 37 | 37.0 |
| Intermenstrual bleeding | 28 | 28.0 |
| Polymenorrhagia | 20 | 20.0 |
| Postmenopausal bleeding | 10 | 10.0 |
| Intermenstrual bleeding | 5 | 5.0 |

The 3D ultrasound findings are summarized in table 3. **Eighteen patients (18%)** had normal findings, while **61 patients (61%)** had thickened endometrium. Of these, **27 (27%)** had isolated thickened endometrium, and **34 (34%)** had thickened endometrium associated with other lesions.

**Table 3: 3D ultrasound findings in the studied patients (n = 100)**

| 3D Ultrasound finding | N | % |
|---|---|---|
| Normal uterine morphology | 18 | 18.0 |
| Thick endometrium (isolated) | 27 | 27.0 |
| Thick endometrium + lesions | 34 | 34.0 |
| — Adenomyosis | 19 | 19.0 |
| — Myoma | 11 | 11.0 |
| — Polyps | 7 | 7.0 |
| Adenomyosis + polyps | 4 | 4.0 |
| Endometrial polyps | 5 | 5.0 |
| Uterine myoma | 5 | 5.0 |

Hysteroscopic findings are shown in table 4. **Thirty patients (30%)** had normal findings, while **39 patients (39%)** had thickened endometrium.

**Table 4: Hysteroscopic findings in the studied patients (n = 100)**

| Hysteroscopic finding | N | % |
|---|---|---|
| Normal uterine cavity | 30 | 30.0 |
| Thick endometrium | 39 | 39.0 |
| Endometrial polyps | 16 | 16.0 |
| Uterine myoma | 5 | 5.0 |
| Thick endometrium + polyps | 8 | 8.0 |
| Adenomyosis | 2 | 2.0 |

The correlation between hysteroscopic and 3D ultrasound findings, analyzed using McNemar's test for matched proportions, is presented in table 5. A statistically significant difference was observed between 3D ultrasound and hysteroscopic findings (**p = 0.018**).

**Table 5: Agreement between 3D ultrasound and hysteroscopic findings (n = 100)**

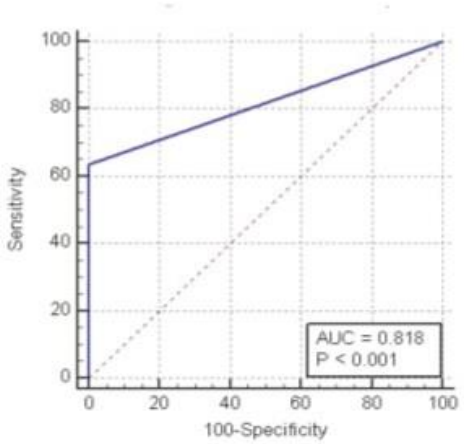
| Diagnosis by hysteroscopy | Diagnosis by 3D US | n | % |
|---|---|---|---|
| Lesion present | Lesion present | 80 | 80.0 |
| Lesion present | Lesion absent | 10 | 10.0 |
| Lesion absent | Lesion present | 14 | 14.0 |
| Lesion absent | Lesion absent | 46 | 46.0 |

**McNemar's test:** p = 0.018

The diagnostic performance of 3D ultrasound for detecting intrauterine lesions is summarized in table 6. Sensitivity was **89%** and specificity was **54%**.

**Table 6: Diagnostic accuracy of 3D ultrasound in detecting intrauterine lesions (n = 100)**

| Parameter | Value, % | 95% CI |
|---|---|---|
| Sensitivity | 89.0 | 81.5 – 94.9 |
| Specificity | 54.0 | 42.6 – 65.4 |
| Positive Predictive Value (PPV) | 66.4 | 57.8 – 74.6 |
| Negative Predictive Value (NPV) | 82.5 | 71.2 – 91.5 |
| Accuracy | 76.0 | 66.8 – 83.8 |




## DISCUSSION

In the current study, 100 women aged 40–55 years who presented with perimenopausal bleeding were included. Each patient underwent both three-dimensional ultrasonography (3D US) and hysteroscopy. As shown in table (2), the most frequent clinical presentation was menorrhagia, reported in 37 cases (37%), followed by metrorrhagia in 28 cases (28%) and polymenorrhagia in 20 cases (20%). These findings are consistent with previous studies; for instance, **El-Khayat *et al.*** examined 50 patients with perimenopausal symptoms and reported menorrhagia as the most frequent presentation (40%), followed by menometrorrhagia (34%) and metrorrhagia (26%) [10], as well as **Pyari *et al.***, who found menorrhagia in 40% of cases [11].

The present study (Table 3) outlines the three-dimensional ultrasound findings, which revealed that 18 cases (18%) had a normal endometrium, 61 cases (61%) showed a thickened endometrium—with 27 cases presenting alone and 34 cases combined with other lesions. Additionally, 7 cases (7%) had endometrial polyps, 11 cases (11%) had uterine myomas, and 19 cases (19%) exhibited signs of adenomyosis. These findings align with the study by **El-Khayat *et al.***, who examined 50 patients with perimenopausal bleeding using both 2D transvaginal sonography and hysteroscopy; their most common findings were a thickened endometrium (32%), followed by endometrial polyps (26%) [10].

A study conducted by **Roberts *et al.*** also supports these findings; in their evaluation of 20 patients with perimenopausal bleeding using transvaginal sonography and hysteroscopy, the most frequent finding was a thickened endometrium, observed in 14 cases (70%) [12].

The present study presents findings that differ from those reported by **Pyari *et al.***, who conducted a study involving 70 patients assessed with transvaginal sonography (TVS). Of these, 50 patients had abnormal uterine bleeding (study group), while 20 had no menstrual irregularities (control group). In the control group, 18 patients showed no abnormalities, one had a myoma, and another had a lost intrauterine contraceptive device. Among the study group, 26% were diagnosed with functional endometrium, 26% had myomas, and 20% exhibited endometrial hyperplasia [11].

These findings differ from the current study in terms of the order and prevalence of lesions. The discrepancy may be explained by differences in the cutoff values for thickened endometrium; **Pyari *et al.*** [11] considered >15 mm in menstruating women and >5 mm in postmenopausal women as abnormal, whereas the present study used a cutoff value of 6 mm. Additionally, **Abo Haemila *et al.*** examined 70 patients with premenopausal bleeding using 3D ultrasound and hysteroscopy, identifying myomas in 14 cases (20%) and polyps in 8 cases (11.4%) [7]. The variation between these studies and the current one may be attributed to differences in patient populations; the prior studies focused on premenopausal women with menorrhagia, while the present study included perimenopausal women presenting with abnormal uterine bleeding (AUB).

Additionally, **Dasgupta *et al.*** studied 252 patients from rural Bengal with perimenopausal bleeding. Transvaginal ultrasound (TVS) revealed normal findings in 90 cases (35.7%), with fibroids being the most common lesion, found in 35 cases (13.9%) [13]. The findings of the present study differ in the types and distribution of lesions

observed, likely reflecting differences in patient selection and diagnostic methods. In this study, hysteroscopic evaluation (Table 4) revealed that 30 patients (30%) had normal uterine cavities, 39 patients (39%) showed thickened endometrium—39% as isolated lesions and 8% combined with other lesions—12 patients (12%) had endometrial polyps, 5 patients (5%) had uterine myomas, and 2 patients (2%) displayed features consistent with adenomyosis.

In this study, the most common lesion detected by hysteroscopy was thickened endometrium, observed in 39 patients (39%), which aligns with findings by **Omar *et al.***, who reported thickened endometrium in 65% of their patients evaluated via hysteroscopy [14]. The current study also supports the results of **Jyotsana and Sharma**, who investigated 75 patients with abnormal uterine bleeding through hysteroscopy and found thickened endometrium to be the most common lesion (22.6%), followed by endometrial polyps (20.3%), uterine myomas (17%), and carcinoma in one case (1.3%) [15].

The current study demonstrates a different distribution of lesions detected via hysteroscopy compared to the findings of **El-Khayat *et al.***, who reported endometrial polyps as the most common lesion (28%), followed by thickened endometrium (20%) [10].

Another hysteroscopic study found that myomas were the most frequent lesion in the study group, observed in 17 cases (34%), followed by endometrial polyps in 9 cases (18%). In contrast, the control group had myomas in 3 cases (15%) and polyps in 1 case (5%) [15].

Similarly, **Dasgupta *et al.*** reported myomas as the most common hysteroscopic finding, occurring in 18.1% of cases [13].

**Abo Haemila *et al.*** identified endometrial polyps as the most prevalent lesion, accounting for 15.7% of cases based on hysteroscopic evaluation [7].

The findings of these studies are not entirely consistent with those of the current study regarding the percentages of various lesions identified through hysteroscopy, which may be attributed to differences in patient selection criteria. In the present study, table (5) illustrates the correlation between hysteroscopic and three-dimensional ultrasound (3D US) findings in the evaluated patients. The sensitivity of 3D US for detecting uterine lesions was 88%, with a specificity of 52% for excluding lesions. The positive predictive value (PPV) was 64.7%, and the negative predictive value (NPV) was 81.3%. These results are comparable to those reported by **El-khayat *et al.***, who found a transvaginal sonography (TVS) sensitivity of 92.3%, specificity of 72.7%, PPV of 92.3%, and NPV of 72.3% [10].

In the study by **Abo Haemila *et al.***, 3D sonography demonstrated a sensitivity of 63.16%, specificity of 80.77%, positive predictive value (PPV) of 54.55%, negative predictive value (NPV) of 85.71%, accuracy of 76.1%, and a relative risk (RR) of 3.82% [7].

However, these findings differ from those of another study involving 105 patients presenting with abnormal uterine bleeding (AUB), in which patients underwent same-day evaluation with transvaginal sonography (TVS) and hysteroscopy. In that study, the sensitivity and specificity of TVS were 79.0% and 45.8%, respectively, while the positive and negative predictive values were 83.0% and 39.3%. The discrepancies between these results may be attributed to differences in ultrasound equipment and operator technique [16].

## CONCLUSION

Although hysteroscopy remains the gold standard for evaluating intrauterine lesions, three-dimensional ultrasonography provides a reasonably accurate, non-invasive, and valuable alternative for assessing the uterine cavity in perimenopausal women. It demonstrates high sensitivity but comparatively low specificity. Therefore, 3D ultrasonography could be utilized as a routine initial diagnostic tool for abnormal uterine bleeding, with follow-up hysteroscopy recommended in cases where 3D ultrasound findings are negative, to compensate for its lower specificity.

**Acknowledgment:** Authors would like to thank Ain Shams University and Suez University.
**Funding:** No funding sources.
**Conflict of interest:** None declared.

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