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Comparative Efficacy of Transvaginal Sonography & Hysteroscopy with Histopathology of Endometrium in Perimenopausal Abnormal Uterine Bleeding

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ABSTRACT

Introduction: Abnormal uterine bleeding (AUB) encompasses any deviation from normal menstrual cycles and is a prevalent issue among reproductive-aged women, accounting for approximately 33% of gynecological referrals. The etiology of AUB is varied, ranging from anovulation and pregnancy to more severe causes like uterine pathologies and coagulopathies. Given the diverse causes, a meticulous diagnostic approach is vital for management. The PALM-COEIN classification aids in the systematic categorization of AUB causes into structural and non-structural factors, facilitating targeted diagnostic investigations. This study emphasizes the need for effective diagnostic tools such as transvaginal sonography (TVS) and hysteroscopy, which, despite their utility, have limitations in accurately distinguishing between different intrauterine pathologies.

Aim & Objective: The primary aim of this study is to evaluate and compare the efficacy of TVS and hysteroscopy against histopathological examination for diagnosing AUB in perimenopausal women. Specific objectives include assessing the diagnostic capabilities of TVS and hysteroscopy in identifying endometrial lesions, comparing their findings, and determining their accuracy, sensitivity, specificity, and predictive values against histopathology.

Methodology: This comparative cross-sectional study was conducted at LLRM Medical College, Meerut, over one year. A total of 172 perimenopausal women with symptoms of AUB were enrolled following ethical approval. Participants underwent detailed clinical evaluations, TVS, and hysteroscopy during the same menstrual cycle to assess endometrial conditions. Both diagnostic tools were evaluated against histopathological findings, serving as the gold standard. Data were analyzed for demographic variables, clinical symptoms, and diagnostic test performance using descriptive and inferential statistics.

Result & Conclusion: The study's findings highlighted a mean participant age of 47.2 years with diverse socioeconomic backgrounds. Clinical presentations varied, with heavy menstrual bleeding being the most common symptom. Both TVS and hysteroscopy identified significant endometrial abnormalities, such as increased endometrial thickness and hyperplasia. However, hysteroscopy showed superior diagnostic accuracy, sensitivity, and specificity compared to TVS, particularly in confirming histopathological findings. The diagnostic yield of directed biopsies during hysteroscopy was notably higher than that of blind biopsies. These results underscore the higher reliability of hysteroscopy over TVS in diagnosing AUB, suggesting that while TVS is suitable for initial assessments, hysteroscopy provides a more definitive diagnostic approach, especially when TVS findings are inconclusive.

Keywords: Abnormal Uterine Bleeding (AUB); Transvaginal Sonography (TVS); Hysteroscopy; Histopathological Examination

INTRODUCTION

AUB is any deviation from the normal menstrual cycle, caused by factors such as anovulation, pregnancy, uterine pathology, and coagulopathies. It is a common complaint among women of reproductive age, accounting for about 33% of

gynecological referrals. The causes of AUB include pregnancy-related issues, infections, uterine neoplasms (both benign and malignant), hormonal imbalances, trauma, foreign bodies, systemic conditions, and medication-induced bleeding. A comprehensive diagnostic approach is essential to determine the cause of AUB, with careful selection of diagnostic tools based on the clinical presentation a thorough history and physical examination are crucial in assessing AUB.[1]

The diagnosis of AUB primarily focuses on identifying the underlying cause of the bleeding, which can vary widely. To aid in this process, the Polyp, Adenomyosis, Leiomyoma, Malignancy, Coagulopathy, Ovulatory Dysfunction, Endometrial Factors, Iatrogenic, Not Otherwise Classified classification system is used, which categorizes the potential causes of AUB into several distinct groups. [2]

Several diagnostic methods are commonly used to identify the causes of abnormal uterine bleeding (AUB) related to the PALM (Polyp, Adenomyosis, Leiomyoma, and Malignancy) classification. These methods include ultrasonography, endometrial sampling, and hysteroscopy, which can be used individually or in combination are used to diagnose AUB in most women. Additional imaging techniques such as contrast-enhanced sonography using saline or gel infusion, three-dimensional ultrasonography, and magnetic resonance imaging (MRI) may also be utilized for a more detailed evaluation of the uterine structure and pathology. [3,4]

TVS is commonly used as the first diagnostic tool for AUB due to its ease of use, speed, and affordability. It provides a non-invasive method to visualize the uterus and helps identify uterine conditions, particularly in categorizing patients who may need further evaluation. However, TVS has limitations in differentiating between various intrauterine pathologies, raising concerns about its accuracy in some cases. Another concern with TVS is the potential risk it poses, with endocavitory probes used in TVS is to generate heat, which can raise the temperature of the transducer's surface by up to 6°C. This may pose safety risks, especially when the thermal index (TI) is between 2.5 and 3.0, with British Medical Ultrasound Society (BMUS) guidelines recommending scan times of less than one minute in such conditions.[5,6] Additionally, the risk of infection from the transvaginal probe is a consideration [7].To address these limitations, hysteroscopy has become a valuable tool for further evaluation of the endometrium, especially when TVS results are inconclusive. Hysteroscopy provides direct visualization of the uterine cavity, allowing for more accurate diagnosis of intrauterine conditions and pathologies. This technique helps identify the cause of AUB and can reduce the need for invasive procedures like hysterectomy.

Traditionally, D&C were used to investigate AUB, but it is not accurate for detecting focal lesions such as endometrial polyps or submucous fibroids, especially when they are small or in difficult-to-reach areas. Hysteroscopy, on the other hand, enables precise removal of these abnormalities. The study aims to compare the diagnostic effectiveness of TVS and hysteroscopy, with histopathological examination of the endometrium as the gold standard for evaluating their accuracy in diagnosing AUB.

Material and methods

The study design was a prospective observational study, carried out at the Department of Obstetrics and Gynecology, Lala Lajpat Rai Memorial (LLRM) Medical College, Meerut, North India. The study conducted from 1st June to 31st May 2024. Approval for the study was obtained from the LLRM Medical College Institutional Ethics Committee (approval no. SC-1/2025/2924). Perimenopausal (40-55 years) women with abnormal uterine bleeding (such as heavy menstrual bleeding, intermenstrual bleeding, irregular and heavy bleeding, regular, frequent, and heavy bleeding, postmenopausal bleeding, continuous bleeding, related to uterine causes), who gave written and informed consent, were included in the study. The women who were not willing to participate, pregnant, had history of some chronic medical disorder, history of drug intake and had vaginal, vulval or cervical causes of bleeding, were excluded from study.

A total of 172 cases were enrolled for the study. Written and informed consent was obtained from them after explaining the entire procedure. All participants were subjected to detailed clinical history and examination, including general, abdominal, and pelvic examinations in the form of per speculum and bimanual examination, to detect any abnormal findings and to exclude any local causes of bleeding. Relevant laboratory investigations, including complete blood count, bleeding time, clotting time, blood sugar (RBS), liver and kidney function tests, thyroid function tests, urine routine and microscopy, and virology (HIV, HBSAG, HCV), were performed.

All patients underwent TVS followed by hysteroscopy in the same cycle (preferably in the postmenstrual period). TVS was performed in the follicular phase of the cycle (days 5-13) after cessation of bleeding and before diagnostic hysteroscopy using a standard 2D ultrasonography machine with a transvaginal 6 MHz probe. All sonographic examinations were performed by an expert sonologist, during which the endometrial cavity was inspected in two perpendicular planes: sagittal and transverse views. Irregularities, thickness, echo pattern, and any distortion of the endometrium were noted. Uterine cavity abnormalities, including polyps, uterine fibroids, uterine congenital anomalies such as septum, adhesions, and endometrial hyperplasia, were also investigated.

After TVS patients underwent diagnostic hysteroscopy, the procedure was performed using a 4 mm diagnostic hysteroscope with a 30-degree angulation. Whenever needed, the cervix was dilated with a No. 5/6 Hegar's dilator. All women were kept nil by mouth for at least 6 hours before the procedure and were given a dose of tetanus toxoid and a single dose of ceftriaxone (1 gm) after a test dose, within 30-45 minutes of the start of the procedure. Normal saline was used as the distension media through the hysteromet, maintaining the uterine pressure below 70 mm (average 30-40 mmHg). The hysteroscopic findings were classified as atrophic endometrium, proliferative (dull pink, relatively thin), secretory (bright pink, uniform), and hyperplastic (fluffy, obscuring the view). Other findings, such as any polyps, submucous fibroids, or local suspicious or unhealthy areas suggestive of endometrial malignancy, were also demarcated, and in indicated cases, hysteroscopically guided biopsy or polypectomy was also performed. If the patient had continuous or heavy bleeding, a thorough curettage was performed to remove all the endometrium (therapeutic curettage). Postoperative care was the same as for other minor procedures. The endometrium was sent to the pathologist in a 10% formalin container. The histopathology report was available within 7 days. The patient was sent home after recovery (4 to 6 hours) on the same day with instructions to return for follow-up in 7-10 days. The endometrium was sent to the pathologist in a 10% formalin container. The pathologist was blinded to the TVS and hysteroscopic findings.

Statistical analysis was performed using descriptive and inferential statistics, including the Chi-Square test. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were analyzed using SPSS version 29.0 and GraphPad Prism version 9.0. A p-value of <0.05 was considered statistically significant.

Result

A total of 172 patients in perimenopausal age group, presenting with menstrual abnormality were studied by TVS and hysteroscopy for this study and further evaluation were done, the data was arranged in MS excel sheet and analyzed statistically.

The table 1 shows that out of the total study participants; the mean age is 47 ± 4years. Regarding socioeconomic status, 18 (10.47%) belong to the upper class, 42 (24.42%) to the upper middle class, 60 (34.88%) to the lower middle class, 48 (27.91%) to the upper lower class, and 4 (2.33%) to the lower class. In terms of education, 22 (12.79%) participants are illiterate, 43 (25.00%) have primary education, 69 (40.12%) have secondary education, and 38 (22.09%) are graduates.

Table 1: sociodemographic and Laboratory profile

Parameter	Category/ Value	Frequency/ Mean t SD / %
Age (years)	-	47 +-4
Socioeconomic Status (Kuppuswamy)	Upper class	18(10.47%)
	Upper middle	42 (24.42%)
	Lower middle	60(34.88%)
	Upper lower	48(27.91%)
	Lower	4(2.33%)
Hemoglobin (g/dl)	-	9.8+- 1.6
TLC (cell/mm3)	-	8200+-1450
Platelets(lakh/mm3)	-	2.4 +- 0.7
Blood group (O+)	-	62(36.05%)

The table 2 illustrates that out of the total study participants, 66 (38.37%) reported heavy menstrual bleeding, 32 (18.60%) experienced intermenstrual bleeding, 44 (25.58%) had irregular heavy bleeding, 18 (10.47%) reported postmenopausal bleeding, and 12 (6.98%) experienced continuous bleeding.

Table 2: Clinical presentation

Symptom	Frequency
Heavy menstrual bleeding	66 (38.37%)
Intermenstrual bleeding	32(18.60%)
Irregular heavy bleeding	44(25.58%)
Postmenopausal bleeding	18(10.47%)
Continuous bleeding	12(6.98%)

The table 3 shows that out of the total, 66 (38.37%) reported heavy menstrual bleeding, 32 (18.60%) experienced intermenstrual bleeding, 44 (25.58%) had irregular heavy bleeding, 18 (10.47%) reported postmenopausal bleeding, and 12 (6.98%) experienced continuous bleeding.

Table 3: TVS findings

Findings	Frequency (%)
Endometrial Thickness >12 mm	78 (45.35%)
Heterogeneous Pattern	44 (38.63%)
Submucosal Fibroid	22 (12.79%)
Endometrial Polyp	18 (10.47%)
Normal endometrium (secretory and proliferative)	10(17.2%)

The above table 4 illustrates that out of the total study participants, 54(31.85%) had normal hysteroscopic findings, rest of them had abnormal findings in the form of endometrial polyp, submucous fibroid, hyperplasia or polypoidal endometrium. Many abnormal findings were in combination of two or more.

Table4: Hysteroscopy findings

Finding	Frequency (%)
Normal Cavity	54(31.85%)
Endometrial Polyp	34 (19.77%)
Submucosal Fibroid	28 (16.28%)
Hyperplasia	46 (26.74%)
Polypoidal endometrium	10(17.2%)

The table 4 shows that out of the total study participants, 20(11.62%) had proliferative endometrium, 44 (25.58%) had hyperplasia, 32 (18.60%) had a polyp,8(4.65%) had malignancy, and 30 (17.44%) had atrophic endometrium, secretory endometrium 18 (10.46%), 28 (16.27%) had Fibroid.

Table 4: Histopathology Findings

Diagnosis	Frequency (%)
Proliferative Endometrium	20(11.62%)
Hyperplasia	44 (25.58%)
Polyp	32 (18.60%)
Malignancy	8 (4.65%)
Atrophic Endometrium	30 (17.44%)
Secretory endometrium	10(5.81%)
Fibroid	28(16.27%)

The table 5 and figure 1 illustrates that out of the total study participants, 77.78% were detected with polyps by TVS, while 88.24% were detected by hysteroscopy, with a p-value of 0.013. For fibroids, 81.82% were detected by TVS and 85.71% by hysteroscopy, with a p-value of 0.221. Regarding hyperplasia, 84.62% were detected by TVS and 82.61% by hysteroscopy, with a p-value of 0.672.

Table 5: Comparative Analysis (TVS vs Hysteroscopy)

Parameter	TVS (%)	Hysteroscopy (%)	p-value
Detection of Polyp	77.78	88.24	0.013
Detection of Fibroids	81.82	85.71	0.221
Detection of Hyperplasia	84.62	82.61	0.672

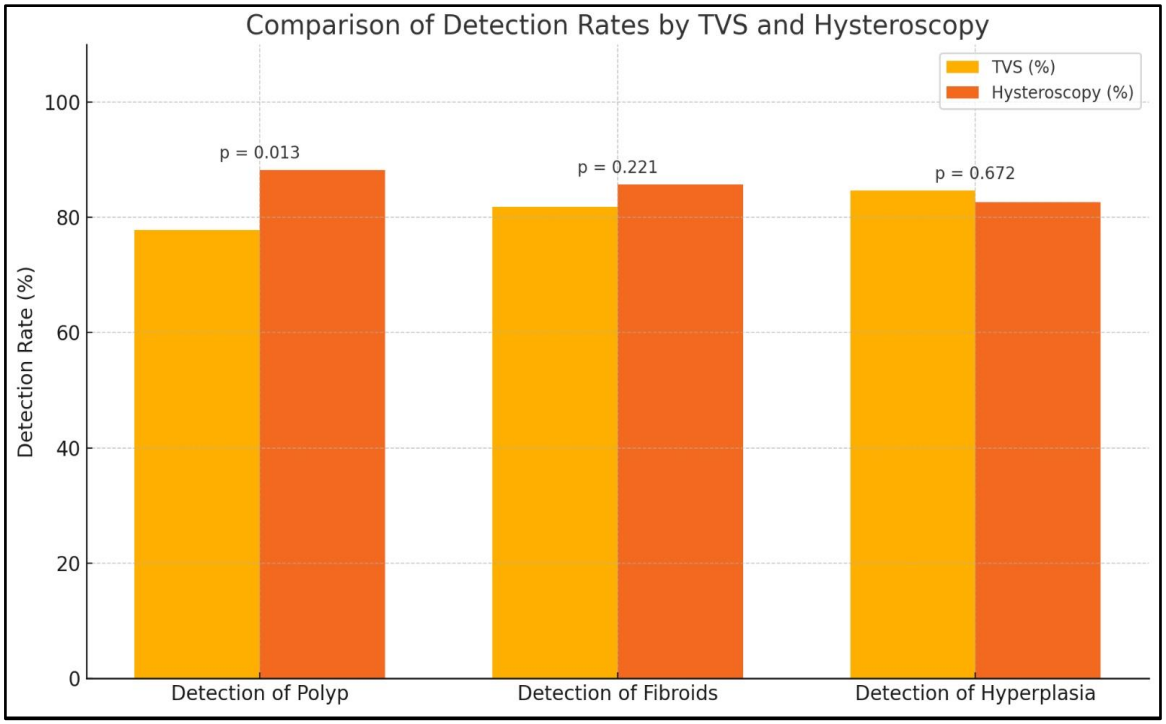

Figure: 1

The table 6 and figure 2 illustrates that, 78.26% showed concordance with HPE for TVS, with a p-value of<0.001, while 92.31% showed concordance with HPE for hysteroscopy.

Table 6: Final Diagnosis Concordance

Method	Concordance with HPE (%)	p-value
TVS	78.26	<0.001
Hysteroscopy	92.31	

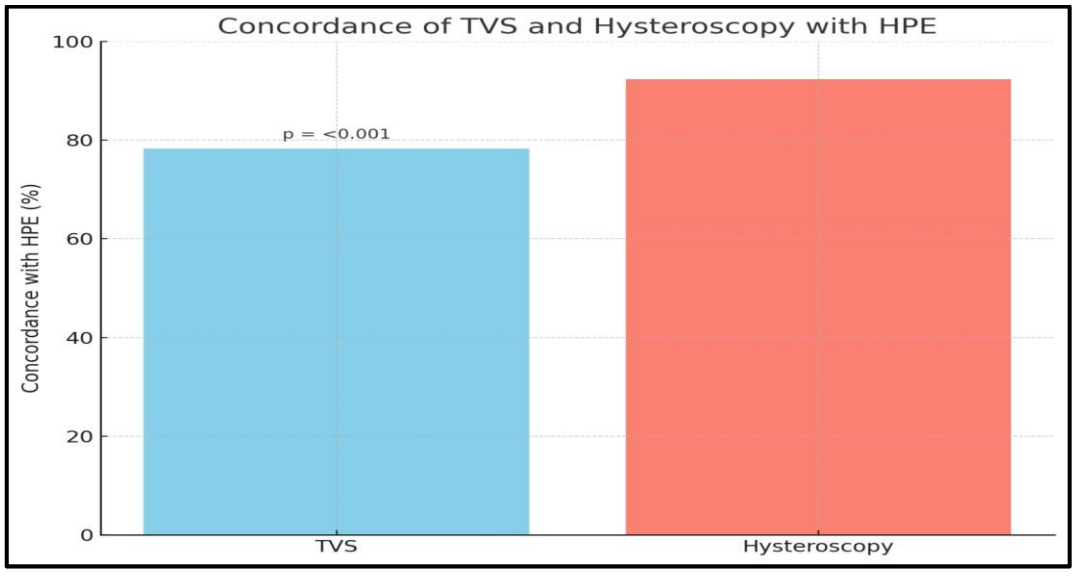

Figure: 2

Discussion

In the present study, the mean age of participants was 47 ± 4 years, aligning with the perimenopausal age range commonly associated with abnormal uterine bleeding (AUB). This concurs with prior studies such as that by Sinha et al. (2018), which also identified the late reproductive to early menopausal transition as a high-risk period for AUB due to hormonal instability [8].

Heavy menstrual bleeding was the most frequent symptom (38.37%), followed by irregular heavy bleeding (25.58%), mirroring the findings of Fraser et al., 2011, who proposed the PALM-COEIN classification to improve the assessment of AUB causes . The hormonal fluctuations typical of perimenopause, particularly anovulatory cycles with unopposed estrogen stimulation, contribute to excessive endometrial proliferation, predisposing women to hyperplasia or neoplastic transformation [9].

Transvaginal sonography (TVS), widely used for initial AUB evaluation due to its non-invasiveness, revealed increased endometrial thickness (>12 mm) in 45.35% of cases. Similar findings were reported by Bano et al. (2020), supporting TVS's utility in detecting endometrial abnormalities, though its sensitivity for focal lesions remains limited [10]. Submucosal fibroids (12.79%) and endometrial polyps (10.47%) were also identified, reflecting the structural pathologies frequently seen in AUB cases (Hegde et al., 2021) [11]. Despite its advantages, TVS may misclassify intrauterine pathologies due to limited spatial resolution and challenges in characterizing endometrial surface irregularities.

Hysteroscopy provided superior diagnostic clarity, with endometrial polyps identified in 19.77% and submucosal fibroids in 16.28% of patients. This is consistent with results from a meta-analysis by Clark et al. (2002), which demonstrated the high sensitivity of hysteroscopy for detecting intrauterine lesions [12]. Additionally, endometrial hyperplasia (26.74%) and polypoidal endometrium (17.2%) were frequently visualized, emphasizing hysteroscopy's role in directly assessing endometrial morphology. It offers the distinct advantage of targeted biopsies, increasing the diagnostic yield compared to blind sampling techniques (Epstein et al., 2001) [13].

Histopathological examination, considered the diagnostic gold standard, confirmed the presence of hyperplasia in 25.58%, endometrial polyps in 18.6%, and malignancy in 4.65% of cases. The concordance of hysteroscopic findings with histopathology was 92.31%, significantly higher than the 78.26% observed for TVS ($p < 0.001$), underscoring the reliability of hysteroscopy. These findings align with the study by Singh et al. (2013), which advocated for hysteroscopy as the most accurate tool for evaluating intrauterine pathology in AUB [14].

The utility of hysteroscopy is particularly evident in cases of postmenopausal bleeding (10.47% in our cohort), where early detection of malignancy or premalignant lesions can significantly alter patient outcomes (Antunes et al., 2011) [15]. The study further supports recommendations from the ACOG guidelines (2020), which favor hysteroscopic-guided biopsy in symptomatic women over blind D&C, particularly for detecting focal lesions like polyps or early carcinoma [16].

Though hysteroscopy is more invasive than TVS, it offers high specificity, reduces false positives, and facilitates therapeutic interventions during the same sitting. A prospective cohort study by Van Dongen et al. (2007) reported a diagnostic accuracy of over 90% for hysteroscopy in identifying polyps and submucosal fibroids, supporting its routine use when non-invasive methods are inconclusive [17].

Importantly, a systematic review by Salim et al. (2011) concluded that combining TVS and hysteroscopy improves diagnostic performance in complex AUB cases [18]. While TVS remains an ideal screening tool due to cost-effectiveness and accessibility, hysteroscopy bridges the diagnostic gap with visual precision, enabling more definitive management plans.

Conclusion

The study on the comparative efficacy of transvaginal sonography (TVS) and hysteroscopy in diagnosing abnormal uterine bleeding (AUB) among perimenopausal women provides insightful conclusions about the strengths and limitations of each diagnostic method, the study demonstrated that while TVS is an excellent first-line, non-invasive diagnostic tool, hysteroscopy plays a crucial role in confirming when TVS results are inconclusive or suggest the presence of complex pathologies. Given the high diagnostic accuracy of hysteroscopy, it is recommended for use in cases where TVS results are inconclusive or suggest significant uterine pathology, ensuring better management of abnormal uterine bleeding in perimenopausal women.

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