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Diagnostic value of transvaginal sonography versus hysteroscopy in patients with endometrial polyps

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Abstract

Endometrial polyps (EPs) are prevalent benign intrauterine growths linked to abnormal uterine bleeding and a potential risk of malignancy. While transvaginal sonography (TVS) is commonly used as a non-invasive screening method, its diagnostic performance varies depending on patient characteristics. Hysteroscopy (HSC), although more invasive, remains the gold standard for EP diagnosis. In this prospective cohort study involving 80 patients with suspected EPs, both TVS and HSC were performed to evaluate their diagnostic accuracy. Overall, HSC demonstrated superior accuracy (95.0% *vs.* 82.5%), specificity (94.4% *vs.* 72.2%), and area under the curve (0.94 *vs.* 0.79) compared to TVS. The sensitivity of TVS was significantly lower in postmenopausal women (66.7%) than in perimenopausal women (86.8%). For polyps smaller than 1.5 cm, TVS also showed markedly reduced sensitivity compared to HSC. However, TVS performance improved in cases with endometrial thickness no less than 8 mm. These findings suggest that while TVS is a useful first-line tool, especially for perimenopausal women or those with thickened endometrium, HSC provides higher diagnostic accuracy and should be prioritized in cases involving postmenopausal status or smaller polyps. *(Afr J Reprod Health 2025; 29 [10]: 18-29).*

Keywords: EPs; TVS; HSC; diagnostic efficacy

Résumé

Les polypes endométriaux (PE) sont des excroissances bénignes intra-utérines fréquentes, associées à des saignements utérins anormaux et à un risque potentiel de malignité. Bien que l'échographie transvaginale (ETV) soit couramment utilisée comme méthode de dépistage non invasive, ses performances diagnostiques varient selon les caractéristiques des patientes. L'hystéroscopie (HSC), bien que plus invasive, demeure la référence absolue pour le diagnostic des PE. Dans cette étude de cohorte prospective incluant 80 patientes suspectées de présenter des PE, à la fois l'ETV et l'HSC ont été réalisées pour évaluer leur précision diagnostique. Globalement, l'HSC a montré une précision supérieure (95,0 % contre 82,5 %), une spécificité plus élevée (94,4 % contre 72,2 %) et une meilleure aire sous la courbe (0,94 contre 0,79) comparativement à l'ETV. La sensibilité de l'ETV était significativement plus faible chez les femmes post-ménopausées (66,7 %) que chez les femmes péri-ménopausées (86,8 %). Pour les polypes de moins de 1,5 cm, l'ETV présentait également une sensibilité nettement réduite par rapport à l'HSC. Toutefois, les performances de l'ETV s'amélioraient chez les patientes avec une épaisseur endométriale d'au moins 8 mm. Ces résultats suggèrent que bien que l'ETV soit un outil de première ligne utile, en particulier chez les femmes péri-ménopausées ou présentant un endomètre épaissi, l'HSC offre une meilleure précision diagnostique et devrait être privilégiée dans les cas de ménopause ou de polypes de petite taille. *(Afr J Reprod Health 2025; 29 [10]: 18-29).*

Mots-clés: EP; TVS; HSC; efficacité diagnostique

Introduction

Endometrial polyps (Eps) are common benign intrauterine lesions, formed by excessive proliferation of local endometrial glands and stroma, clinically presenting as abnormal uterine bleeding, infertility, or asymptomatic incidental findings[1]. Epidemiological data show that the prevalence of EPs in women of reproductive age is 10%-40%, and is markedly associated with hormone replacement therapy, obesity, and increasing age [2,3]. Although most polyps are benign, they may increase the risk of endometrial precancerous lesions (with a malignancy rate of about 2.3%), making early and precise diagnosis crucial[4].

At present, TVS is widely recommended as the main tool for the initial diagnosis of EPs due to its non-invasive, convenient, and low-cost characteristics[5]. However, recent studies have shown that the sensitivity and specificity of TVS in diagnosing EPs vary. One study found that the sensitivity, specificity and accuracy of TVS in

diagnosing EPs were 39.8%, 72.7%, and 52.8%, respectively, indicating its low accuracy in detecting polyps[6]. In recent years, several studies have pointed out that high-resolution ultrasound techniques (such as 3D ultrasound) can partially improve the detection rate, but have not yet been widely adopted in clinical practice[7]. In contrast, hysteroscopy (HSC) is regarded as the "gold standard" for diagnosing EPs, allowing direct visualization of the uterine cavity and simultaneous biopsy or treatment[8]. However, its invasive procedure may cause pain, infection, or uterine perforation, and it is costly[9].

Currently, comparative studies of TVS and HSC have been reported. A systematic review and meta-analysis evaluated the accuracy of TVS, SCSH, and HSC in diagnosing EPs in women with abnormal uterine bleeding. The results showed that the sensitivity and specificity of TVS were 62% and 73%, respectively, while those of HSC were 92% and 85%[10]. In another study, the sensitivity and specificity of TVS in detecting endometrial lesions were 84.0% and 86.8%, respectively, while the corresponding values for HSC were 98.9% and 95.1%[11]. Additionally, the accuracy of TVS in diagnosing EPs is influenced by various factors, such as endometrial thickness, lesion size, and patient age. Sanin-Ramirez *et al*. found that in perimenopausal women, the diagnostic sensitivity and specificity of TVS were 56.9% and 94.5%, respectively, while in postmenopausal women, they were 50.2% and 84.7%, respectively[12]. However, a 2024 study found that the diagnostic sensitivity and specificity of TVS in perimenopausal women were 89.7% and 66.7%, respectively, while those of HSC were 94.8% and 76.2%, respectively[13].

Although TVS demonstrates value in the initial screening of EPs, its diagnostic accuracy is affected by various factors and is lower than that of HSC. HSC, the gold standard for diagnosing EPs, has higher sensitivity and specificity, but its invasiveness and high cost limit its use in initial screening. Therefore, further comparison of the diagnostic value of TVS and HSC for EPs in different clinical contexts is of great significance for optimizing the diagnostic process and increasing diagnostic accuracy. This study aimed to systematically evaluate the distinctions in diagnostic efficacy between TVS and HSC for EPs through a prospective cohort design, using pathological diagnosis as the gold standard. This study focused on exploring the impact of polyp morphological characteristics and patient baseline factors (such as menopausal status) on the choice of the two methods, to provide high-quality evidence for optimizing individualized diagnostic and treatment pathways.

Methods

The study was a prospective controlled study, comparing the clinical efficacy of TVS and HSC in the diagnosis of EPs. In the study, all enrolled cases were evaluated using postoperative pathological results as the gold standard.

Study subjects

The study recruited 80 patients suspected of having EPs who visited the Department of Gynecology,Xiangnan University Affiliated Hospital from January 2022 to March 2025, and who were scheduled for hysteroscopic examination due to abnormal uterine bleeding, menstrual disorders, or assisted reproductive reasons. All patients underwent TVS before surgery and HSC with pathological biopsy during or after surgery. The inclusion and exclusion criteria for all patients were as follows.

The inclusion criteria were: (1) Age 18–65 years; (2) Clinical suspicion of EPs (*e.g.,* abnormal uterine bleeding, infertility, abnormal endometrial echoes detected by ultrasound); (3) Signed informed consent before surgery, agreeing to undergo TVS, HSC, and histopathological examination.

The exclusion criteria were: (1) Pregnant or breastfeeding women; (2) Presence of acute genital tract infection, coagulation dysfunction, or severe cardiopulmonary disease; (3) History of previous uterine surgery (*e.g.,* myomectomy, adhesiolysis of intrauterine adhesions); (4) Presence of malignancy or confirmed endometrial cancer; (5) Uterine malformations or intrauterine adhesions severely affecting examination results; (6) Incomplete clinical data or missing follow-up; (7) Severe cardiac, hepatic, renal dysfunction, or other serious internal medical conditions.

The total sample size was 80 cases. Based on the data from the pilot study (TVS sensitivity approximately 85%, HSC approximately 95%), the sample size was calculated using PASS software to meet the minimum requirement (α=0.05, β=0.2).

Examination methods

TVS examination

All subjects underwent TVS before surgery, performed by two physicians with intermediate or higher professional titles and over 5 years of experience in gynecological and obstetrical ultrasound diagnosis. The equipment used was the Affiniti 70 color Doppler ultrasound diagnostic instrument (Philips Healthcare, Netherlands) with a 5–9 MHz probe. Before the examination, patients were instructed to empty their bladder and were placed in the lithotomy position. The probe was wrapped with sterile coupling gel and gently inserted into the vagina. A systematic scan of the uterine body, endometrial cavity, and bilateral adnexal regions was performed. The morphology of the endometrial cavity and the endometrial thickness (maximum anteroposterior diameter) were observed, as well as the presence of focal endometrial thickening or polypoid echoes, polyp size, base width, clear demarcation from the endometrium, and the presence of a "single feeding vessel" sign in the lesion under color Doppler mode. Two physicians independently reviewed the images and recorded the results. In case of disagreement, a third expert made the final decision.

HSC examination and pathological diagnosis

All patients were scheduled for elective HSC within one week after TVS, performed by gynecologists with the title of associate chief physician or above. The equipment used was the full HD HSC system produced by Karl Storz GmbH & Co. KG, Tuttlingen, Germany (Hysteroscope 26153BA, outer diameter 4.0 mm, field of view 30°), along with a high-frequency resectoscope system and cold light source and camera system. Acute pelvic inflammatory disease was excluded preoperatively, patients were fasting for 6 hours, and blood was prepared if necessary. For postmenopausal women, if cervical atrophy and canal stenosis made dilation difficult, local estrogen preparations [ethinyl estradiol tablets (0.05 mg × 20 tablets, Shanghai Modern Pharmaceutical Co., Ltd., China] 0.05 mg, once daily via the posterior fornix of the vagina) was used 3–5 days before surgery to soften the cervix and increase the success rate of hysteroscope insertion. The anesthesia method was assessed by anesthesiologists and combined with the patient's voluntary choice; intravenous anesthesia [using propofol (10 mg/mL, 20 mL, Sinopharm Group Guorui Pharmaceutical Co., Ltd., China) 1–2 mg/kg intravenous injection] was preferred for those who met the indications, ensuring sedation, analgesia, and smooth operation. For those with contraindications to anesthesia or unwilling to accept intravenous anesthesia, local cervical paracervical nerve block anesthesia was chosen, using 2% lidocaine injection [2%, 20 mL, Tianjin Jinyao Group Leren Tang Pharmaceutical Factory, China), injected at four points (3, 6, 9, 12) at the base of the cervix to relieve discomfort during dilation. Post-anesthesia, the cervix was progressively dilated using a Hegar dilator up to size 7. Subsequently, the hysteroscope was carefully introduced under continuous irrigation with 0.9% normal saline (China Resources Sanjiu, Shenzhen, China) to systematically evaluate the uterine cavity. The examination included assessment of the cavity's contour, the smoothness of the endometrial surface, and the presence of solitary or multiple polypoid lesions. Key characteristics, such as lesion size, location, pedicle width, and vascularity, were documented in detail. Therapeutic interventions, including electrosurgical resection, cold knife excision, or targeted biopsy for histopathological analysis, were performed as clinically indicated.

After the operation, the uterine cavity was rinsed with normal saline, the polyp tissue was completely preserved, and sent to the pathology department for paraffin embedding and HE staining, with two pathologists separately reviewing the slides to confirm the pathological results. All hysteroscopic biopsy or postoperative specimens were reviewed blindly by two pathologists, and EPs were diagnosed (pathological criteria: interstitial fibrosis with glandular dilation, surface covered by proliferative endometrium). Both TVS and HSC for all patients were completed within 3–7 days after menstruation to minimize interference from endometrial thickness fluctuations and maximize the visualization rate and detection rate of intrauterine lesions.

Observed indicators

(1) The number of EPs detected by pathological biopsy, TVS, and HSC was recorded.
(2) The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and

comparative accuracy of TVS and HSC for the diagnosis of endometrial polyps were calculated.

(3) Data on menopausal status, polyp size, and endometrial thickness of the subjects were collected and grouped as follows:

Menopausal status was observed, including perimenopausal group and postmenopausal group.

Polyp size was measured: <1.5 cm group and ≥1.5 cm group. If the polyp diameter is greater than 15 mm (*i.e.,* 1.5 cm), the risk of proliferative lesions will markedly increase. Moreover, polyps with a diameter exceeding 2 cm are more likely to be associated with malignant lesions in postmenopausal women[14];

Endometrial thickness was measured: <8 mm group and ≥8 mm group. In perimenopausal and postmenopausal women, an endometrial thickness exceeding 8 mm is considered abnormal and may indicate the presence of endometrial hyperplasia or other lesions[15].

The diagnostic efficacy distinctions between TVS and HSC were analyzed in each subgroup.

Statistical methods

All data analyses were performed using IBM *SPSS Statistics 26.0* (IBM Corp., Armonk, NY, USA). For measurement data that followed a normal distribution, the mean ± standard deviation ($\bar{x} \pm s$) was used, and intergroup comparisons were made using the independent samples t-test; if the data did not meet the normal distribution or homogeneity of variance, nonparametric test methods, such as the Mann-Whitney U test, were used. Sensitivity, specificity, PPV/NPV, and overall accuracy were calculated based on a 2×2 table. The distinctions in sensitivity/specificity between TVS and HSC were assessed using the paired McNemar test. Receiver operating characteristic (ROC) curve analysis was performed using *MedCalc 22.013*, and the contrast of area under the curve distinctions was conducted using the DeLong test, with results presented as area under the curve (95% confidence interval (CI)). For stratified analyses based on menopausal status, polyp size, and endometrial thickness, the Bonferroni method was used to correct for multiple comparisons, with the significance threshold adjusted to α=0.017 (0.05/3). Count data were described as frequencies (percentages), and intergroup comparisons were made using the Pearson chi-square test or Fisher's exact test (when the theoretical frequency was <5). All hypothesis tests were two-sided, with a significance level set at $P < 0.05$, except for the corrected analyses.

Ethical considerations

The study was approved by the Ethics Committee of Xiangnan University Affiliated Hospital (approval number: K2022-001-01) and followed the Declaration of Helsinki

Results

General statistical information

The average age of the subjects was 45.2 ± 7.8 years, and the average endometrial thickness was 7.6 ± 2.5 mm. According to the postoperative pathological diagnosis, a total of 62 cases (77.5%) were finally diagnosed with EPs, and 18 cases (22.5%) were non-EPs, including proliferative endometrium, submucosal myomas, and endometrial polypoid pseudolesions.

Diagnostic results of TVS and HSC

The diagnostic results of TVS and HSC were summarized (Table 1). The diagnostic results of TVS showed that there were 58 cases (72.5%) of EPs and 22 cases (27.5%) of non-EPs; the diagnostic results of HSC showed that there were 62 cases (77.5%) of EPs and 18 cases (22.5%) of non-EPs.

Contrast of diagnostic efficacy of TVS and HSC

ROC curves were further plotted (Figure 1) to compare the diagnostic efficacy of TVS and HSC (Table 2). As against TVS, HSC demonstrated higher accuracy (95.0% vs 82.5%, χ^2=4.62, P=0.032), specificity (94.4% vs 72.2%, χ^2=4.89, P=0.027), and NPV (85.0% vs 59.1%, χ^2=4.04, P=0.044) in the diagnosis of EPs, with statistically meaningful distinctions. Although the sensitivity of HSC (95.2%) was also higher than that of TVS (85.5%), the distinction did not reach statistical significance (χ^2=3.16, P=0.075).

Table 1: Diagnostic 2×2 table for EPs by TVS and HSC (using pathological results as the gold standard)

Method	Pathological EPs	Pathological non-EPs	Total
TVS (EPs)	53	5	58 72.5%)
TVS (non-EPs)	9	13	22(27.5%)
HSC (EPs)	61	1	61(77.5%)
HSC (non-EPs)	1	17	18 22.5%)
Total	62	18	80

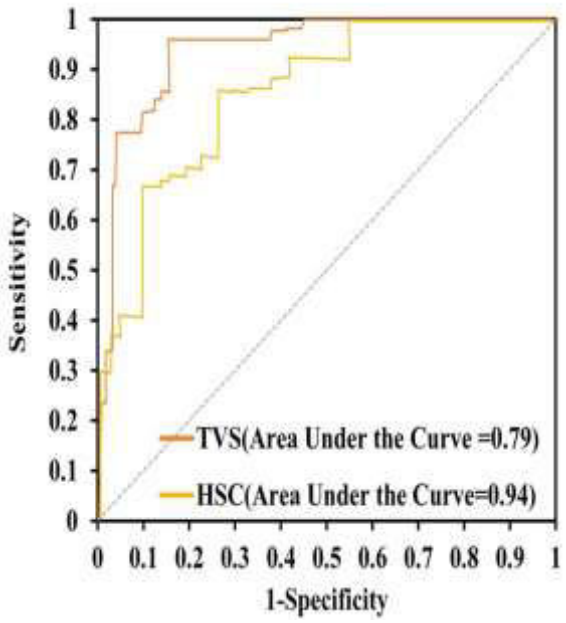

Figure 1: ROC curve for the diagnosis of EPs by TVS and HSC.

ROC curve analysis further indicated that the area under the curve of HSC (0.94) was markedly higher than that of TVS (0.79), Z=2.11, P=0.035, suggesting that HSC had superior overall diagnostic performance.

Contrast of diagnostic efficacy of TVS and HSC in different subgroups

The impact of menopausal status, polyp size, and endometrial thickness on the diagnostic efficacy of TVS and HSC in EPs was explored, and comparisons were made using indicators such as sensitivity, specificity, PPV, NPV, and area under the curve.

Contrast of diagnostic efficacy of TVS and HSC in different menopausal status groups

Participants were divided into perimenopausal (n=52) and postmenopausal (n=28) groups based on their menopausal status. The results showed that in the perimenopausal group, TVS had a sensitivity of 86.8%, specificity of 75.0%, PPV of 88.2%, NPV of 72.0%, overall accuracy of 82.7%, and area under the curve of 0.84 (95% CI: 0.73–0.94); HSC had a sensitivity of 94.7%, specificity of 100.0%, PPV of 100%, NPV of 90.9%, overall accuracy of 96.2%, and area under the curve of 0.97 (95% CI: 0.92–1.00). In the postmenopausal group, the sensitivity of TVS markedly decreased to 66.7%, with specificity of 71.4%, PPV of 80.0%, NPV of 55.6%, accuracy of 67.9%, and area under the curve of only 0.68 (95% CI: 0.49–0.86); HSC maintained high diagnostic efficacy, with sensitivity of 91.7%, Spe of 100.0%, PPV of 100%, NPV of 87.5%, accuracy of 94.6%, and area under the curve of 0.96 (95% CI: 0.88–1.00). Intergroup comparisons revealed that in postmenopausal women, the sensitivity, accuracy, and area under the curve of TVS were markedly lower than those in perimenopausal women (P < 0.05), while the diagnostic efficacy of HSC did not show visible distinctions between different menopausal statuses (P > 0.05) (Figure 2).

Contrast of diagnosis performance of TVS and HSC in different polyp size groups

Patients were divided into <1.5 cm group (n=43) and ≥1.5 cm group (n=37) based on the maximum diameter of polyps in pathological results. In the <1.5 cm group, TVS had a sensitivity of 69.0%, specificity of 70.0%, PPV of 82.1%, NPV of 52.6%, accuracy of 69.8%, and area under the curve of 0.71 (95% CI: 0.58–0.84); HSC had a sensitivity of 92.9%, specificity of 100.0%, PPV of 100%, NPV of 83.3%, accuracy of 95.3%, and area under the curve of 0.96 (95% CI: 0.89–1.00). In the ≥1.5 cm group, the sensitivity of TVS increased to 91.2%, with specificity of 75.0%, PPV of 93.9%, NPV of 66.7%, accuracy of 88.5%, and area under the curve of 0.89 (95% CI: 0.78–0.99); HSC still demonstrated extremely high diagnosis performance (sensitivity 100.0%, specificity 100.0%, area under the curve 1.00).

Table 2: Comparison and statistical analysis of the diagnostic efficacy of TVS and HSC for Eps

Indicators	TVS	HSC	χ^2	*P*
Sensitivity	85.5% (53/62)	95.2% (59/62)	3.16	0.075
Specificity	72.2% (13/18)	94.4% (17/18)	4.89	0.027*
Accuracy	82.5% (66/80)	95.0% (76/80)	4.62	0.032*
PPV	91.4% (53/58)	98.3% (59/60)	2.73	0.098
NPV	59.1% (13/22)	85.0% (17/20)	4.04	0.044*
Area under the ROC curve	0.79	0.94	Z=2.11	0.035*

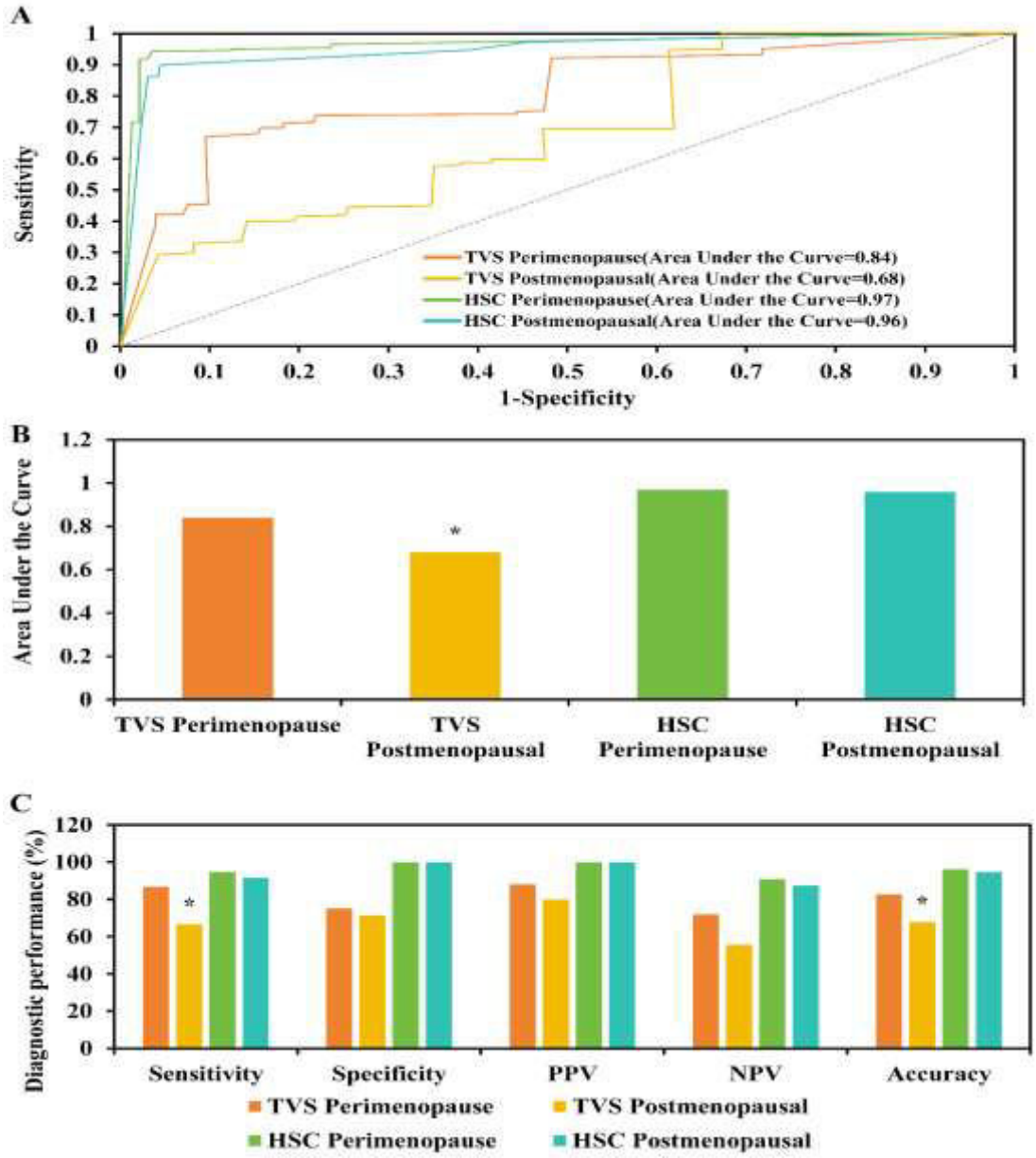

Figure 2: Contrast of diagnosis performance of TVS and HSC in perimenopausal and postmenopausal groups. (A: ROC curve; B: area under the curve; C: Contrast of sensitivity, specificity, PPV, NPV, and overall accuracy, "*": $P < 0.05$ as against TVS in the perimenopausal group)

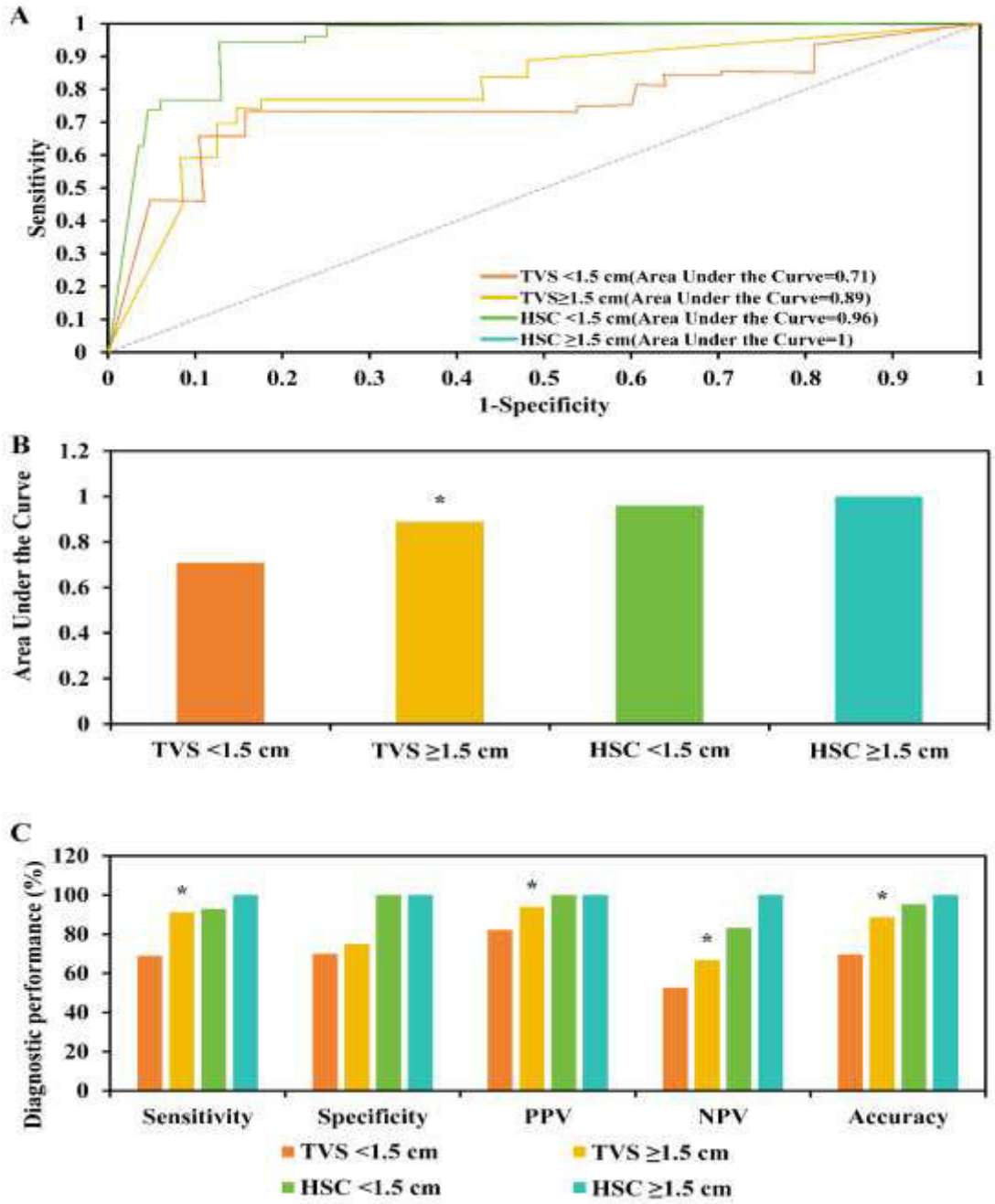

Figure 3: Contrast of diagnosis performance of TVS and HSC in groups with <1.5 cm and ≥1.5 cm polyps. (A: ROC curve; B: area under the curve; C: Contrast of sensitivity, specificity, PPV, NPV, and overall accuracy, "*": $P < 0.05$ as against TVS in <1.5 cm group)

The analysis showed that the diagnosis performance of TVS was markedly better in patients with larger polyps (≥1.5 cm) than in those with smaller polyps ($P < 0.05$), while HSC maintained high consistency and accuracy in polyps of all sizes ($P > 0.05$) (Figure 3).

Contrast of diagnosis performance of TVS and HSC in different endometrial thickness groups

Patients were divided into <8 mm group (n=36) and ≥8 mm group (n=44) based on endometrial thickness.

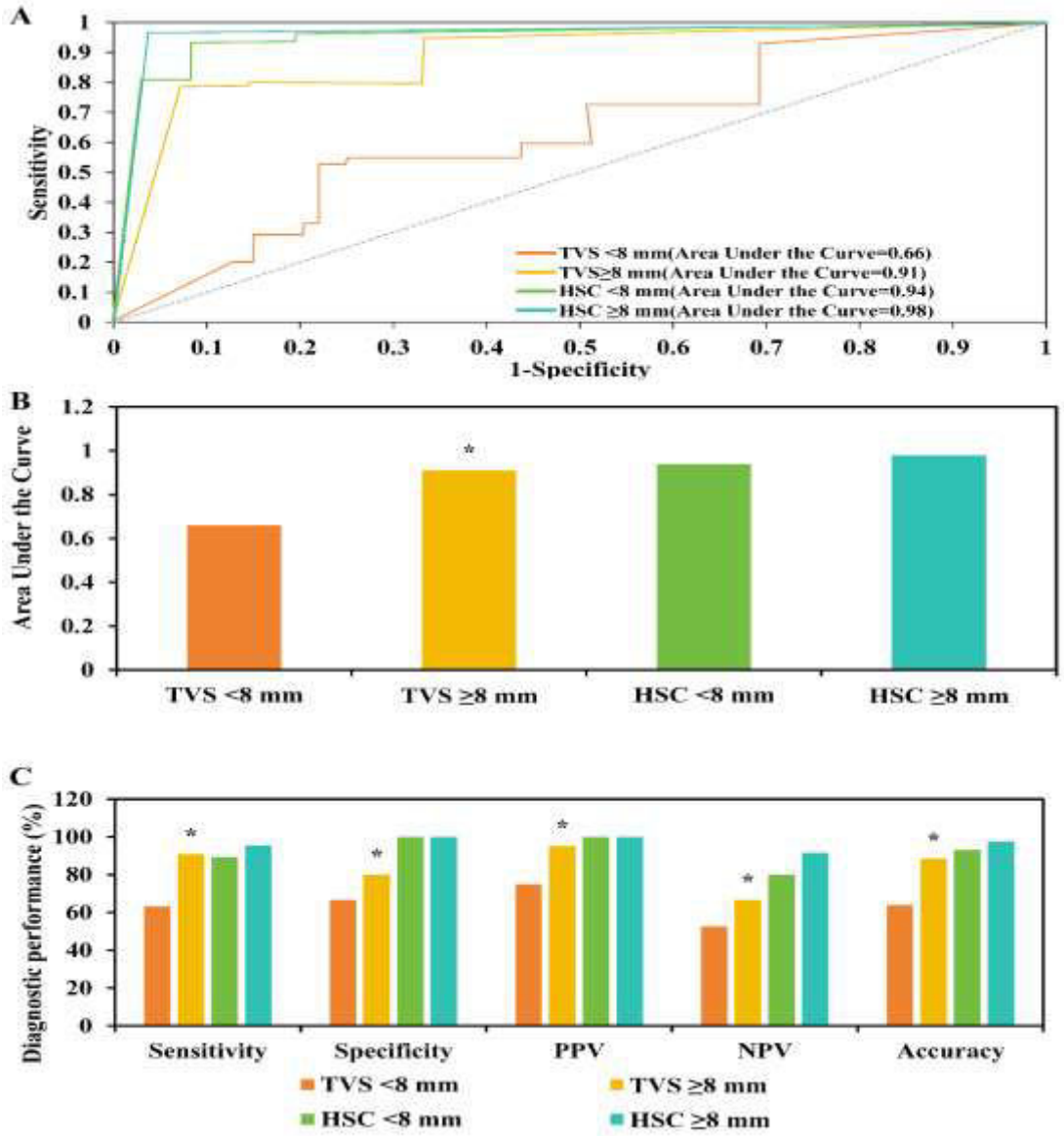

Figure 4: Contrast of diagnosis performance of TVS and HSC in groups with <8 mm and ≥8 mm endometrial thickness. (A: ROC curve; B: area under the curve; C: Contrast of sensitivity, specificity, PPV, NPV, and overall accuracy, "*": $P < 0.05$ as against <8 mm group)

In the <8 mm group, TVS had a sensitivity of 63.2%, specificity of 66.7%, PPV of 75.0%, NPV of 52.6%, accuracy of 64.0%, and area under the curve of 0.66 (95% CI: 0.51–0.82); HSC had a sensitivity of 89.5%, specificity of 100.0%, PPV of 100%, NPV of 80.0%, accuracy of 93.1%, and area under the curve of 0.94 (95% CI: 0.86–1.00). In the ≥8 mm group, the diagnosis performance of TVS improved [sensitivity 90.9%, specificity 80.0%, PPV 95.2%, NPV 66.7%, accuracy 88.6%, area under the curve 0.91 (95% CI: 0.83–0.99)], while HSC continued to show excellent accuracy (sensitivity 95.5%, specificity 100.0%, area under the curve 0.98). Intergroup comparisons revealed that the diagnostic performance of TVS was markedly higher in patients with endometrial thickness ≥8 mm than in those with thinner endometrium ($P < 0.05$), suggesting that thicker endometrium may enhance the visualization rate of EPs by TVS; whereas the diagnosis performance of HSC was not affected by endometrial thickness and remained at a high level ($P > 0.05$) (Figure 4).

Discussion

This prospective cohort study compared the diagnostic performance of TVS and HSC for EPs and conducted stratified analyses in different clinical subgroups. The results showed that HSC markedly outperformed TVS in multiple indicators, including sensitivity, specificity, accuracy, and area under the curve, especially in postmenopausal women and patients with smaller polyp volume or thinner endometrial thickness, where the diagnostic capability of TVS was more markedly limited.

The results showed that the sensitivity, specificity, and accuracy of TVS for EPs in the overall population were 85.5%, 72.2%, and 82.5%, respectively, while the corresponding values for HSC were 95.2%, 94.4%, and 95.0%, respectively. These results are consistent with several recent studies. For example, Xia and Jin's study pointed out that the sensitivity, specificity, and accuracy of ultrasound diagnosis of EPs were 90.0%, 66.7%, and 87.9%, respectively, while those of HSC were 96.7%, 66.7%, and 93.9%, respectively[16]. In addition, the area under the curve of TVS in this article was 0.79, lower than the 0.94 of HSC, further supporting HSC as the current gold standard for clinical diagnosis of EPs. Recent literature has further indicated that the sensitivity of TVS is markedly affected by polyp location and endometrial thickness. For instance, a study proposed that the sensitivity of 2D TVS in diagnosing EPs was 80.6%. However, the location of the polyp and the thickness of the endometrium markedly affect the diagnostic accuracy of TVS. In particular, in cases with thinner endometrial thickness or atypical polyp location, the diagnostic capability of TVS may decrease[17]. Some studies have pointed out that endometrial thickness is an important indicator for predicting endometrial abnormalities. For every 1 mm increase in endometrial thickness, the odds of abnormal diagnosis increase by 16.3%. This suggests that in cases with thinner endometrial thickness, TVS may miss polyps and other lesions[18,19]. This article also confirmed that endometrial thickness is an important factor affecting the accuracy of TVS. In the group with endometrial thickness ≥8 mm, the diagnostic sensitivity of TVS was 90.9%, while it dropped to 63.2% in the <8 mm group, indicating that thicker endometrium helps improve the echo contrast of the lesion and enhance visualization. HSC, on the other hand, maintained high accuracy in all endometrial thickness groups, further highlighting its stability.

Clinical studies have shown that endometrial thickness is closely related to a woman's menopausal status. Before menopause, influenced by the cyclical changes of ovarian hormones, endometrial thickness fluctuates periodically[20]; while after menopause, due to the visible decrease in estrogen levels, the endometrium usually becomes thinner[21]. The results of subgroup analysis showed that TVS had a better diagnostic performance in perimenopausal women (sensitivity 86.8%, area under the curve 0.84), but it markedly decreased in postmenopausal women (sensitivity 66.7%, area under the curve 0.68). This may be related to the atrophy of the endometrium and the decrease in endometrial echo contrast after menopause, making small lesions difficult to distinguish, which indirectly supports the advantage of TVS in diagnosing EPs in patients with thick endometrium. In a study involving 570 postmenopausal women, researchers evaluated the efficacy of TVS and endometrial cytology test (ECT) in screening for endometrial cancer and precancerous lesions. The results showed that the sensitivity of TVS was 86.8%, but the specificity was only 20.4%, indicating that TVS may have a higher false-positive rate in postmenopausal women and needs to be combined with other examination methods to improve diagnostic accuracy[22]. In contrast, HSC maintained high sensitivity (≥91.7%) in different menopausal statuses, indicating that it is not affected by endometrial status and is suitable for a wider population.

Moreover, the diagnosis performance of TVS is closely related to the size of EPs. In the group with polyps ≥1.5 cm, the sensitivity of TVS can reach 91.2%, but it drops to 69.0% in the group with polyps <1.5 cm. This result is basically in line with the report by Rouholamin et al., who found that polyps with a diameter greater than 1.5 cm (i.e., 15 mm) are easier to identify in TVS, with a detection rate of 79%, compared to 47% in HSC. This indicates that larger polyps have higher detectability in TVS [23]. However, HSC showed a sensitivity of >92% and a specificity of 100% in different volume groups, indicating its good ability to identify small lesions. It should be noted that although HSC is the gold standard, its invasiveness, equipment cost, and technical requirements limit its feasibility as a

routine screening tool. TVS still has irreplaceable value as an initial screening method, especially in young women or preoperative evaluation. Recent studies have also suggested that the sensitivity of TVS can be further improved by introducing 3D ultrasound or SIS. Studies have confirmed that the sensitivity of SIS in detecting EPs is 79.16%, with a specificity of 100%, highly consistent with HSC and pathological results[24].

Despite the systematic contrast of the diagnostic value of TVS and HSC for EPs in this article, there are still several undeniable limitations. This article was a single-center retrospective analysis, with cases from the gynecology outpatient department of Xuancheng People's Hospital from December 2022 to March 2025, involving 80 patients. The proportion of non-EPs was low (22.5%, 18 cases), which may overestimate the specificity of TVS and limit its generalizability[25,26]. The limited sample size led to insufficient statistical power in subgroup analyses based on menopausal status, polyp size, and echo type, with some distinctions showing trends but not reaching significance. Future research should conduct multicenter, large-sample prospective studies to verify the robustness of the conclusions of the study [27]. To enhance the diagnostic value of TVS, future efforts can be explored in three aspects: first, applying deep learning models to assist image recognition and improve the detection rate of small polyps; second, combining molecular markers such as CRP, IL-6, ER, and PR to enhance the ability to distinguish between benign and malignant lesions; and third, promoting non-invasive technologies such as 3D SIS to enhance lesion assessment and reduce dependence on HSC.

In summary, HSC still has irreplaceable advantages in the diagnosis of EPs, but TVS, as a non-invasive initial screening method, still has important application value in specific populations. In clinical practice, the choice of examination method should be made comprehensively based on the patient's age, endometrial status, and lesion characteristics to promote individualized and stratified diagnostic strategies.

Strengths and weaknesses

This prospective cohort study, using pathological confirmation as the gold standard, compared the diagnostic performance of TVS and HSC in detecting EPs, with stratified analyses based on menopausal status, polyp size, and endometrial thickness. The results demonstrated that HSC exhibited superior overall sensitivity, specificity, and accuracy compared to TVS, particularly in postmenopausal women and patients with smaller polyps or thinner endometria, where it showed more consistent performance. TVS retained some value as an initial screening tool in perimenopausal women or those with thicker endometria but was prone to missed diagnoses in cases of small polyps or thin endometria. The study adhered to standardized protocols, with all examinations performed by experienced operators under ethical guidelines. Limitations included a relatively small sample size (n=80), its single-center design, reliance primarily on 2D-TVS without evaluation of advanced techniques (*e.g.,* 3D ultrasound or saline infusion sonography), and lack of assessment regarding patient experience or cost-effectiveness. These findings suggest that clinical practice should tailor diagnostic approaches based on patient age, menopausal status, endometrial thickness, and polyp characteristics, utilizing TVS for initial screening while reserving HSC for definitive diagnosis. Future multicenter studies with larger cohorts and integration of novel imaging technologies may refine noninvasive diagnostic strategies, improving efficiency and reducing reliance on invasive procedures.

Conclusion

TVS and HSC have their own advantages in the diagnosis of EPs. TVS, as a convenient, non-invasive, and cost-effective imaging tool, has important value in the screening stage, especially for initial diagnosis or patients with contraindications to the procedure. However, it is prone to miss small polyps, those with a wide base, or those with atypical echoes. Although HSC is relatively complex and somewhat invasive, its role as the gold standard is undeniable, as it allows direct visualization of intrauterine lesions and simultaneous treatment. In clinical practice, the choice of diagnostic method should be made based on individual characteristics such as patient age, menopausal status, clinical symptoms, and ultrasound findings to maximize diagnostic and therapeutic benefits. Under the premise of ensuring diagnostic accuracy, optimizing TVS technology, introducing artificial intelligence

and molecular marker detection, and promoting new non-invasive imaging technologies can potentially improve the early diagnosis rate and management efficiency of EPs while reducing the consumption of medical resources. Future research should focus on the integration of technologies and the construction of multimodal diagnostic pathways to provide more scientific, precise, and cost-effective diagnostic and treatment strategies for gynecological diseases.

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Authors' contributions

YSH and DL conceptualized this study. YSH and DL conducted the literature review. YSH and DL worked on the data analysis and interpretation of results. All authors contributed to the discussion of the findings. All authors read and approved the final manuscript.

Conflict of interests

The authors declare no competing interests

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