

Correlation of Transvaginal Ultrasound and Hysteroscopy in Evaluation of Endometrial Pathology

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Abstract: Background: Accurate diagnosis of endometrial pathology is essential for appropriate management of abnormal uterine bleeding (AUB). This study evaluated the correlation between transvaginal ultrasonography (TVS) and hysteroscopy using histopathological examination (HPE) as the gold standard. Methods: A prospective observational study was conducted over 18 months in the Department of Radiodiagnosis, N.S.C.B. Medical College and Hospital, Jabalpur. Forty-five women with suspected endometrial pathology underwent TVS followed by hysteroscopy, and findings were correlated with histopathology. Diagnostic performance was assessed using sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), accuracy, and Cohen's kappa coefficient. Results: The majority of patients were aged 41–50 years (33.3%) and premenopausal (62.2%). Irregular uterine bleeding was the most common presenting complaint (44.4%). Endometrial polyp was the commonest lesion, detected in 46.7% of cases on TVS and 48.9% on both hysteroscopy and HPE. TVS showed excellent correlation with HPE, with only one false-negative case of endometrial polyp, whereas hysteroscopy demonstrated complete concordance with histopathological findings. TVS achieved a sensitivity of 97.4%, specificity of 100%, PPV of 100%, NPV of 87.5%, and overall diagnostic accuracy of 97.8%. Hysteroscopy demonstrated 100% sensitivity, specificity, PPV, NPV, and diagnostic accuracy. Cohen's kappa indicated almost perfect agreement between TVS and HPE ($\kappa = 0.93$) and perfect agreement between hysteroscopy and HPE ($\kappa = 1.00$). Conclusion: Both TVS and hysteroscopy showed excellent correlation with histopathology in the evaluation of endometrial pathology. TVS is an effective first-line, non-invasive screening modality, whereas hysteroscopy provides superior diagnostic accuracy and should be considered the preferred modality for definitive evaluation and targeted biopsy of suspected intrauterine lesions.

Keywords: Abnormal uterine bleeding, Transvaginal ultrasonography, Hysteroscopy, Histopathology, Endometrial pathology, Diagnostic accuracy

1. Introduction

Abnormal uterine bleeding represents one of the most frequent and clinically significant gynaecological complaints encountered in women across reproductive and perimenopausal age groups, often affecting their physical health, emotional wellbeing, social functioning, and professional life.[1] In severe cases, abnormal uterine bleeding may necessitate urgent management including volume replacement therapy and haemostatic treatment, while persistent or prolonged symptoms may ultimately require surgical evaluation to determine the underlying pathology.[2] Accurate identification of the cause of abnormal uterine bleeding is therefore essential for guiding appropriate treatment and improving patient outcomes.[3]

Transvaginal ultrasonography has emerged as an important first-line diagnostic modality in the evaluation of endometrial pathology because of its ability to assess uterine morphology,

endometrial thickness, and the integrity of the endomyometrial junction. [4] It provides valuable information regarding anatomical abnormalities such as fibroids, adenomyosis, endometrial polyps, and adnexal pathology, and helps in identifying variations in endometrial thickness that may indicate underlying disease processes. [5] As a non-invasive, widely available, and relatively cost-effective imaging technique, transvaginal ultrasonography is frequently used as an initial screening tool in women presenting with abnormal uterine bleeding.[4]

Recent advances in minimally invasive gynaecological techniques have led to increasing use of hysteroscopy as an effective method for evaluating intrauterine pathology.[6] Hysteroscopy allows direct visualization of the endocervical canal and uterine cavity using fibre-optic illumination and distension media, thereby enabling identification of focal lesions that may not be detected on imaging studies alone. [6] The ability to inspect the uterine cavity in detail and evaluate the surface characteristics, vascular pattern, and glandular openings of the endometrium makes hysteroscopy a valuable diagnostic tool in patients with abnormal uterine bleeding. [7]

Clinical studies comparing transvaginal ultrasonography and hysteroscopy have demonstrated differences in their diagnostic performance in evaluating endometrial pathology. While ultrasonography is effective in detecting intramural fibroids and adenomyosis, hysteroscopy has greater efficacy in identifying intracavitary lesions such as endometrial polyps and submucosal myomas. [8] The complementary roles of these two modalities suggest that their combined use may enhance diagnostic precision in women presenting with abnormal uterine bleeding. [9] A systematic evaluation of these modalities helps determine their individual and combined effectiveness in detecting endometrial pathology and contributes to improved clinical management of patients with abnormal uterine bleeding.

The study was conducted to assess the correlation of transvaginal ultrasound and hysteroscopy in evaluation of endometrial pathology.

2. Materials and Methods

The prospective observational study was conducted in the Department of Radiodiagnosis,

N.S.C.B. Medical College and Hospital, Jabalpur (M.P.), over a period of 18 months, from July 2024 to December 2025, after receiving ethical clearance from the Institutional Ethics Committee. 45 participants fulfilling the inclusion criteria were selected for the study.

Inclusion Criteria

Any patient referred to the Radio diagnosis department for evaluation of endometrial pathologies whose hysteroscopy can be indicated.

Exclusion Criteria

Patients with Uterine fibroids other than submucosal fibroid, who were not eligible for transvaginal ultrasonography, with incomplete data, who did not provide consent for transvaginal ultrasonography.

3. Procedure

All patients fulfilling inclusion criteria were evaluated using transvaginal ultrasonography after obtaining informed consent.

Transvaginal ultrasonography was performed using high-frequency endovaginal probes under standard aseptic precautions.

First transabdominal ultrasound was done, followed by transvaginal ultrasound after taking consent. Patients were asked to empty their urinary bladder completely, positioning was in lithotomy position, with hips slightly elevated by a cushion. Then TVS probe with a sterile cover and ample conductive gel to remove air bubbles was used transducer was introduced gently into the vaginal canal to obtain optimal visualization of pelvic structures with probe marker pointing towards the 12 o'clock position (upwards) to display the sagittal view. Then probe was adjusted to obtain midsagittal view where endometrial stripe is visible from fundus to endocervix. For axial (transverse) view, probe was rotated 90 degrees counterclockwise so the marker points towards patient's right side (9 o'clock)

Endometrial thickness, echogenicity, and structural characteristics were assessed carefully. Particular attention was paid to detection of intracavitary lesions such as endometrial polyps, hyperplasia, and submucosal fibroids.

Color Doppler imaging was used wherever required to assess vascularity of suspected lesions and to improve characterization of abnormalities.

Following ultrasonographic evaluation, hysteroscopy was performed wherever clinically indicated. Findings observed during hysteroscopy were recorded and correlated with ultrasonographic observations for assessment of diagnostic agreement.

All findings were documented systematically in a predesigned case record format.

Data were collected prospectively using a structured data recording format. The collected data were analysed using IBM SPSS software version 23.0. Appropriate statistical methods were applied to organize and interpret the data. Tabulation of observations was performed using descriptive statistical techniques. Frequencies and percentages were calculated for categorical variables. Parametric and non-parametric statistical tests were applied wherever appropriate to determine correlation between transvaginal ultrasonography and hysteroscopic findings.

4. Results

Table 1: Baseline Characteristics of the Study Population (n = 45)

Characteristic	Frequency (n)	Percentage (%)
Age Group (years)		
20–30	6	13.3
31–40	11	24.4
41–50	15	33.3
51–60	9	20
60	4	8.9
Menopausal Status		
Premenopausal	28	62.2
Postmenopausal	17	37.8
Presenting Complaint		
Irregular bleeding	20	44.4
Postmenopausal bleeding	15	33.3
Menorrhagia	6	13.3
Infertility	2	4.4
Others	2	4.4

Values are presented as frequency (n) and percentage (%). Total study population = 45.

The age of patients ranged from 20 to over 60 years, with the majority of patients belonging to the 41–50 years age group, accounting for 33.3% of the study population. This was followed by the 31–40 years age group (24.4%) and the 51–60 years age group (20.0%). Patients aged above 60 years constituted 8.9% of the cases, while those in the 20–30 years age group accounted for 13.3%.

With respect to menopausal status, the majority of patients were premenopausal, comprising 62.2% of the study population, whereas postmenopausal women accounted for 37.8% of the cases.

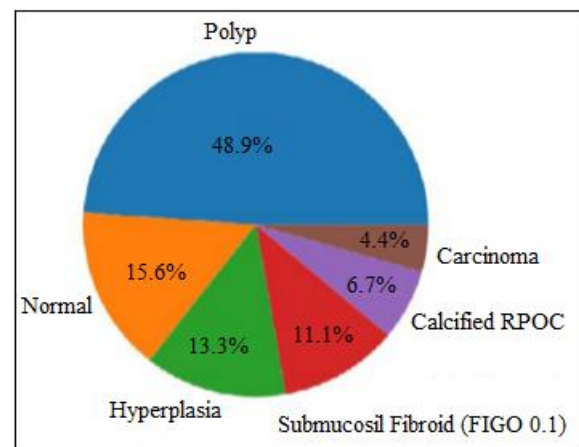
The most common presenting complaint in the study population was irregular bleeding, observed in 44.4% of cases. Postmenopausal bleeding accounted for 33.3% of patients. Menorrhagia was reported in 13.3% of cases. Infertility and other complaints were less common, each contributing to 4.4% of the cases.

Table 2: Distribution of Endometrial Pathology Detected by Transvaginal Ultrasound, Hysteroscopy, and Histopathological Examination (n = 45)

Diagnosis	TVS n (%)	Hysteroscopy n (%)	Histopathology n (%)
Endometrial Polyp	21 (46.7)	22 (48.9)	22 (48.9)
Normal Endometrium	8 (17.8)	7 (15.6)	7 (15.6)
Endometrial Hyperplasia	6 (13.3)	6 (13.3)	6 (13.3)
Submucosal Fibroid (FIGO 0/1)	5 (11.1)	5 (11.1)	5 (11.1)
Calcified Retained Products of Conception (RPOC)	3 (6.7)	3 (6.7)	3 (6.7)
Endometrial Carcinoma	2 (4.4)	2 (4.4)	2 (4.4)
Total	45 (100)	45 (100)	45 (100)

Endometrial polyp was the most frequently detected lesion across all three diagnostic modalities, identified in 46.7% of cases on transvaginal ultrasonography (TVS) and in 48.9% of cases on both hysteroscopy and histopathological examination (HPE). Normal endometrium was reported in 17.8% of patients on TVS and 15.6% on both hysteroscopy and HPE. The frequencies of endometrial hyperplasia

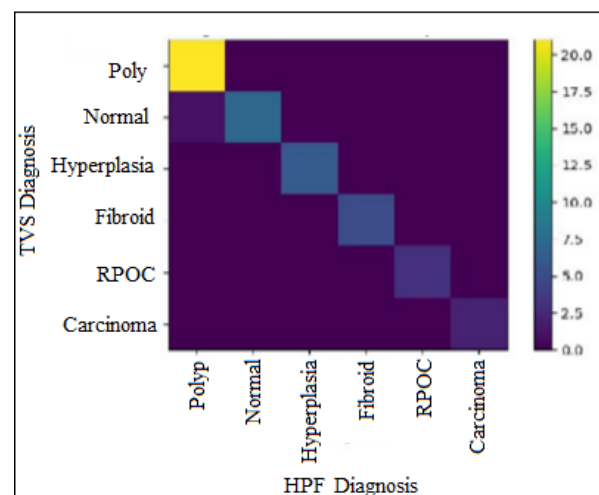
(13.3%), submucosal fibroid (FIGO type 0/1) (11.1%), calcified retained products of conception (6.7%), and endometrial carcinoma (4.4%) were identical on hysteroscopy and HPE, whereas TVS underestimated endometrial polyps and overestimated normal findings by one case.

**Table 3:** Comparison of TVS Findings with Histopathological Diagnosis (n = 45)

TVS Diagnosis	HPE Polyp Fig.1:	HPE Normal Pie chart diagnosis	HPE Endometrial Hyperplasia	HPE Submucosal Fibroid	HPE RPOC	HPE Endometrial Carcinoma	Total
Polyp	21	0	0	0	0	0	21
Normal	1	7	0	0	0	0	8
Endometrial Hyperplasia	0	0	6	0	0	0	6
Submucosal Fibroid	0	0	0	5	0	0	5
RPOC	0	0	0	0	3	0	3
Endometrial Carcinoma	0	0	0	0	0	2	2
Total	22	7	6	5	3	2	45

On comparison of transvaginal sonography (TVS) findings with histopathological examination (HPE), a high degree of concordance was observed between the two modalities. All cases diagnosed as polyp on TVS were confirmed on histopathology except for one case, which was reported as normal on TVS but subsequently identified as a polyp on HPE. All cases of hyperplasia, submucosal fibroid (FIGO type 0 and 1), calcified retained products of conception (RPOC), and carcinoma diagnosed on TVS showed complete agreement with histopathological findings.

Association between imaging findings and histopathological diagnosis was assessed using the Chi-square test, with Fisher's exact test applied where appropriate due to small cell frequencies. The association was found to be statistically highly significant ($p < 0.001$).

**Figure 2:** Graphical representation of comparison between transvaginal sonography (TVS) findings and histopathological diagnosis**Table 4:** Comparison of Hysteroscopy Findings with Histopathological Diagnosis (n = 45)

Hysteroscopy	HPE Polyp	HPE Normal	HPE Endometrial Hyperplasia	HPE Fibroid	HPE Calcified RPOC	HPE Endometrial Carcinoma	Total
Polyp	22	0	0	0	0	0	22
Normal	0	7	0	0	0	0	7
Endometrial Hyperplasia	0	0	6	0	0	0	6
Fibroid	0	0	0	5	0	0	5
Calcified RPOC	0	0	0	0	3	0	3
Endometrial Carcinoma	0	0	0	0	0	2	2
Total	22	7	6	5	3	2	45

Comparison of hysteroscopic findings with histopathological examination demonstrated complete agreement across all diagnostic categories. All cases identified on hysteroscopy were confirmed on histopathological examination, with no discrepancy observed.

Statistical analysis using the Chi-square test revealed a statistically highly significant association between hysteroscopic findings and histopathological diagnosis ($p < 0.001$).

Chi-square test was used to assess the association between categorical variables, and a p-value of <0.05 was considered statistically significant.

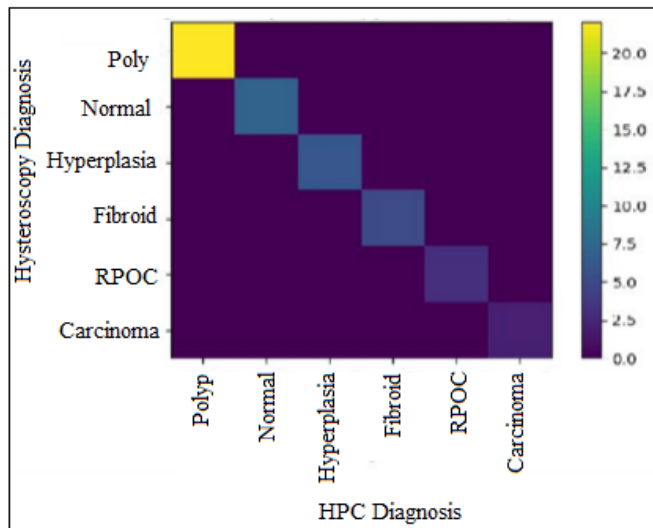


Figure 3: Graphical representation of comparison between hysteroscopic findings and histopathological diagnosis

Table 5: Diagnostic Accuracy of TVS and Hysteroscopy

Parameter	TVS (%)	Hysteroscopy (%)
Sensitivity	97.4	100
Specificity	100	100
PPV	100	100
NPV	87.5	100
Accuracy	97.8	100

The diagnostic accuracy of transvaginal sonography (TVS) and hysteroscopy was evaluated by comparing their findings with histopathological examination (HPE), which was considered the gold standard.

For TVS, the sensitivity was found to be 97.4%, specificity was 100%, positive predictive value (PPV) was 100%, negative predictive value (NPV) was 87.5%, and overall diagnostic accuracy was 97.8%.

For hysteroscopy, sensitivity, specificity, PPV, NPV, and diagnostic accuracy were all found to be 100%.

Table 6: Agreement analysis between modalities using Cohen kappa (binary classification)

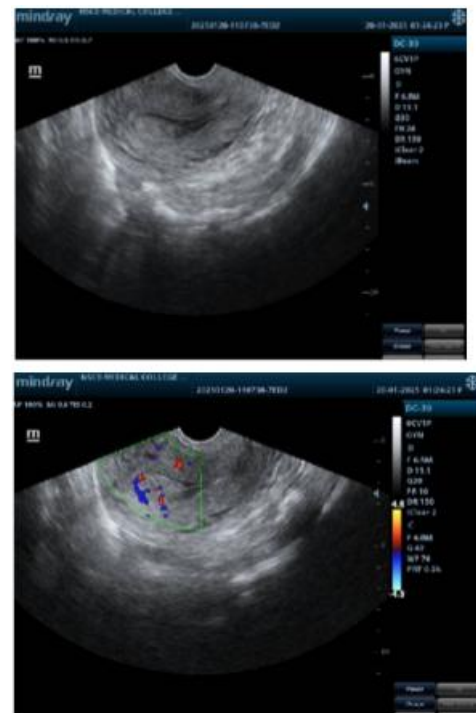
Modality Compared	Kappa Value ($\hat{\kappa}$)	Strength of Agreement
TVS vs HPE	0.93	Almost perfect
Hysteroscopy vs HPE	1.00	Perfect

Agreement between transvaginal sonography (TVS), hysteroscopy, and histopathological examination (HPE) was assessed using Cohen kappa coefficient for binary classification of presence or absence of pathology. The agreement between TVS and HPE was found to be almost perfect, with a kappa value of 0.93. Hysteroscopy demonstrated perfect agreement with histopathological diagnosis, with a kappa value of 1.00.

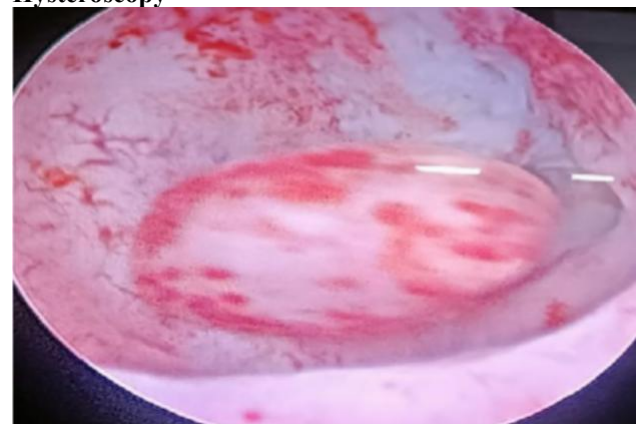
6. Case Study

CASE 1- Patient presented with irregular menstrual bleeding for one month. TVS shows hyperechoic lesion with stalk like vascularity suggesting endometrial polyp, hysteroscopy also shows endometrial polyp, histopathology findings confirmed the same.

TVS



Hysteroscopy

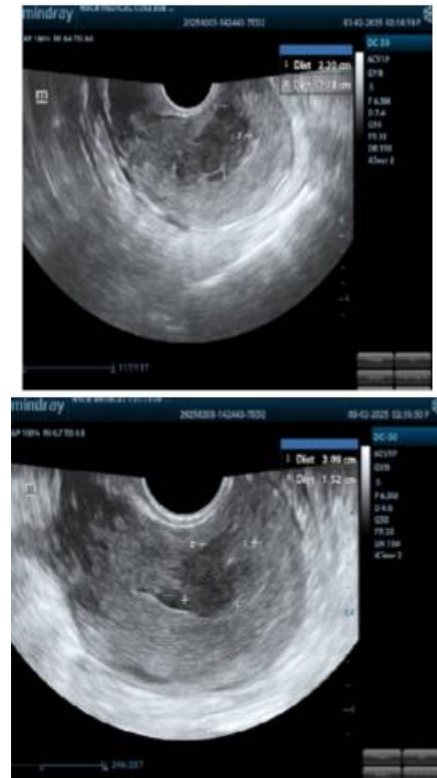


Case 2: A patient presented with menorrhagia, on TVS showed endometrial polyp with endocervical polyp, on hysteroscopy multiple endometrial polyp were found with an endocervical polyp, histopathology findings confirmed the same

TVS



TVS



Hysteroscopy



Case 3: A patient presented with irregular bleeding shows submucosal fibroid (FIGO 1) on TVS, on hysteroscopy also shows submucosal fibroid, histopathology findings also confirmed fibroid



Hysteroscopy-



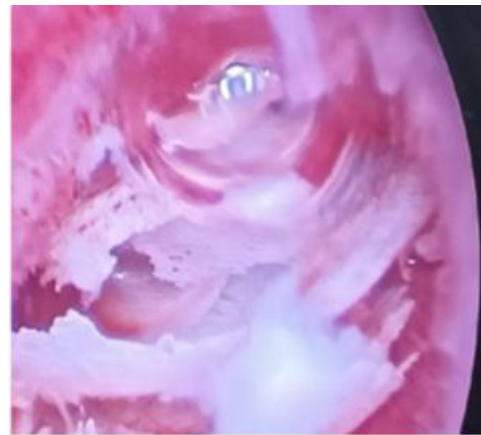
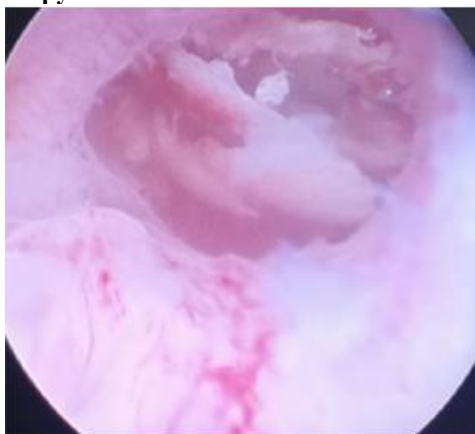
Case 4: A patient come with irregular bleeding and history of dilatation and curettage 2 yrs back, on TVS, diagnosis of calcified retained products of conception (calcified RPOC)

was given; on hysteroscopy- calcified plates were seen arranged horizontally in uterine cavity likely suggesting calcified RPOC.

Histopathology confirmed the same TVS



Hysteroscopy-



7. Discussion

The aim of the present study was to evaluate and correlate the diagnostic efficacy of transvaginal ultrasonography and hysteroscopy in the detection of endometrial pathology, using histopathological examination as the gold standard for final confirmation.

The demographic profile of the present study demonstrated a predominance of women in the 41–50-year age group, with the majority being premenopausal (62.2%), indicating that evaluation of endometrial pathology is most frequently required during the perimenopausal period. Irregular uterine bleeding was the leading presenting complaint, followed by postmenopausal bleeding, emphasizing abnormal uterine bleeding as the principal indication for endometrial assessment. These findings are consistent with those of Veena and Shivalingaiah [10], Sharma and Tiwari [11], Swathi et al. [12], and Verma et al. [13], who similarly reported a predominance of perimenopausal women presenting with bleeding abnormalities requiring further evaluation. Likewise, Goyal et al. [14] identified abnormal uterine bleeding as the most common clinical indication for uterine cavity assessment.

Endometrial polyp was the most prevalent lesion identified across all diagnostic modalities, accounting for 46.7% of cases on transvaginal ultrasonography (TVS) and 48.9% on both hysteroscopy and histopathological examination (HPE). The identical distribution of pathological lesions between hysteroscopy and histopathology underscores the high diagnostic capability of hysteroscopy for lesion characterization, whereas TVS underestimated endometrial polyps by a single case. Comparable findings have been reported by Goyal et al. [14], and Tuersun et al. [15], although the latter observed endometrial hyperplasia as the predominant pathology, reflecting variations in study populations.

Correlation of TVS findings with histopathology revealed excellent diagnostic concordance, with only one false-negative case of endometrial polyp and complete agreement for endometrial hyperplasia, submucosal fibroids, calcified retained products of conception, and endometrial carcinoma. These findings support the role of TVS as a highly effective first-line, non-invasive imaging modality for evaluating endometrial pathology. Similar diagnostic performance has been reported by Goyal et al. [14] whereas Veena and

Shivalingaiah [10] and Swathi et al. [12] demonstrated comparatively lower sensitivity of TVS for detecting focal intracavitary lesions, particularly endometrial polyps.

Hysteroscopic findings exhibited complete concordance with histopathological diagnosis, with no false-positive or false-negative results. All cases of endometrial polyps, hyperplasia, submucosal fibroids, calcified retained products of conception, and endometrial carcinoma were accurately identified. This observation highlights the superior diagnostic performance of hysteroscopy attributable to direct visualization of the endometrial cavity. Similar findings have been reported by Yela et al. [17], who concluded that hysteroscopy provides greater diagnostic precision than TVS for intracavitary uterine pathology.

Assessment of diagnostic accuracy demonstrated excellent performance of both modalities, although hysteroscopy showed absolute diagnostic superiority. TVS achieved a sensitivity of 97.4%, specificity of 100%, positive predictive value of 100%, negative predictive value of 87.5%, and overall diagnostic accuracy of 97.8%, whereas hysteroscopy demonstrated 100% sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy. These findings are in agreement with those reported by Yela et al. [16], and Tuersun et al. [15], who consistently demonstrated significantly higher diagnostic accuracy of hysteroscopy compared with TVS, supporting its role as the reference diagnostic modality for endometrial evaluation.

Agreement analysis further substantiated these findings, with TVS demonstrating almost perfect agreement with histopathology (Cohen's $\kappa = 0.93$) and hysteroscopy demonstrating

perfect agreement ($\kappa = 1.00$). The exceptionally high kappa values indicate excellent reliability and reproducibility of both diagnostic techniques, while confirming the superior concordance of hysteroscopy with the histopathological gold standard. Comparable agreement has been reported by Goyal et al. [14], whereas Kumari and Gupta [17] emphasized that TVS serves as an excellent screening investigation and hysteroscopy provides definitive lesion characterization, with histopathological examination remaining indispensable for confirmation of diagnosis. These findings collectively reinforce the complementary roles of TVS and hysteroscopy in the diagnostic algorithm for endometrial pathology.

The present study has several methodological strengths, including a direct comparison of transvaginal ultrasonography and hysteroscopy with histopathological examination as the gold standard, enabling robust assessment of diagnostic performance. Uniform evaluation of all patients using a standardized diagnostic protocol, comprehensive lesion-wise correlation, and calculation of diagnostic indices including sensitivity, specificity, predictive values, diagnostic accuracy, and Cohen's κ enhanced the validity of the findings. Inclusion of both premenopausal and postmenopausal women with a broad spectrum of endometrial pathologies further improves the clinical applicability of the results. However, the study is limited by its relatively small sample size, single-centre

design, limited representation of less common lesions, and absence of interobserver variability and long-term follow-up analyses. Additionally, subgroup analyses based on lesion characteristics and assessment of cost-effectiveness and patient acceptability were not performed, which may limit the generalizability of the findings.

8. Conclusion

Overall, the study findings support a sequential diagnostic approach in which TVS is used as the primary screening tool and hysteroscopy is employed for confirmation, further evaluation, and targeted biopsy in suspected or symptomatic cases. Histopathological examination remains the definitive gold standard for final diagnosis, especially in hyperplasia and carcinoma. In overall terms, the study confirms a strong correlation between transvaginal ultrasonography, hysteroscopy, and histopathology in the evaluation of endometrial pathology, while also demonstrating that hysteroscopy offers the highest diagnostic accuracy and the most reliable correlation with final tissue diagnosis.

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