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CORRELATION OF TRANSVAGINAL ULTRASONOGRAPHY WITH HISTOPATHOLOGY IN THE DIAGNOSIS OF ADENOMYOSIS

Obstetrics & Gynaecology

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ABSTRACT

Introduction: Adenomyosis is a benign uterine condition where endometrial glands and stroma invade the myometrium, often presenting with dysmenorrhea, menorrhagia, or dyspareunia. Historically diagnosed post-hysterectomy, transvaginal ultrasonography (TVS) now serves as the primary diagnostic tool, with reported sensitivity of 65–81% and specificity of 65–100%. Early diagnosis via TVS is crucial for fertility preservation. **Materials and Methods:** This prospective study involved 50 women (October 2021–September 2023) presenting with abnormal uterine bleeding and sonographic features suggestive of adenomyosis. TVS findings were classified using MUSA criteria, documenting direct (myometrial cysts, hyperechoic islands, sub-endometrial echogenic lines) and indirect signs (globular uterus, asymmetric wall thickening, fan-shaped shadowing, trans-lesional vascularity, irregular junctional zone). All patients underwent hysterectomy, with histopathology (HPE) serving as the diagnostic gold standard. **Results:** Histopathology confirmed adenomyosis in 46 of 50 patients (92%). Direct TVS features showed high diagnostic correlation: myometrial cysts had 93.5% sensitivity and 75% specificity; sub-endometrial echogenic lines had 95.7% sensitivity and 100% specificity; hyperechoic islands had 97.8% sensitivity and 100% specificity. Indirect features were less specific, though an irregular junctional zone had 97.8% sensitivity. The overall positive predictive value of TVS for adenomyosis was 92%. **Conclusion:** TVS, using MUSA criteria, is a reliable, first-line diagnostic tool for adenomyosis. Direct sonographic features closely align with histopathological findings, enabling early diagnosis and guiding conservative management to preserve fertility.

KEYWORDS

INTRODUCTION

Adenomyosis is a benign uterine disorder characterized by endometrial glands and stroma within the myometrium, leading to a diffusely enlarged, tender uterus. It typically affects multiparous women over 40, presenting with heavy menstrual bleeding, dysmenorrhea, dyspareunia, and chronic pelvic pain. Symptoms often overlap with fibroids and endometriosis, complicating diagnosis. Up to 50% of cases have coexisting leiomyomas. Traditionally, adenomyosis was confirmed only after hysterectomy.

Advancements in imaging, particularly transvaginal ultrasonography (TVS), now allow non-invasive, presurgical diagnosis. TVS is the first-line modality due to its accessibility and cost-effectiveness, with a reported sensitivity of 65–81% and specificity of 65–100%. MRI provides slightly higher accuracy but is less accessible.

The MUSA criteria improve TVS diagnostic accuracy, classifying features as direct signs (myometrial cysts, hyperechoic islands, sub-endometrial echogenic lines) and indirect signs (globular uterus, wall asymmetry, fan-shaped shadowing, translesional vascularity, and irregular junctional zone). Direct features are highly predictive, while indirect signs provide supportive context.

Adenomyosis is now increasingly recognized in younger women and infertility patients, due to improved imaging and criteria. Early diagnosis enables conservative management such as hormonal therapy and uterine-sparing interventions.

This study aims to evaluate the diagnostic accuracy of TVS by correlating sonographic features with histopathology, identifying the most predictive signs to refine diagnostic protocols and promote fertility-preserving care.

MATERIALS AND METHODS

Study Design and Setting: A prospective observational study was conducted in the Department of Obstetrics and Gynecology of a tertiary care teaching hospital. The study duration was two years (Jan 2023 to Jan 2025). Institutional ethics approval was obtained, and informed consent was taken from all participants.

Study Population: We enrolled 50 women who presented to the gynecology outpatient department with complaints of abnormal uterine bleeding and dysmenorrhea that raised clinical suspicion for adenomyosis. All patients underwent a detailed evaluation including history and physical examination. Importantly, each patient had a transvaginal ultrasound demonstrating features suggestive of adenomyosis and had elected to undergo definitive surgical management (hysterectomy) for relief of symptoms .

Ultrasound Evaluation

All patients underwent pre-operative transvaginal ultrasonography (TVS) using high-resolution endo-vaginal probes, following standardized MUSA criteria. Direct signs assessed included:

1. Intra-myometrial cysts (anechoic areas within the myometrium)
2. Hyperechoic islands (heterogeneous echotexture)
3. Sub-endometrial echogenic lines or buds extending into the myometrium

Indirect Signs Included:

1. Globular uterine enlargement (rounded, increased anterior-posterior dimension)
2. Asymmetrical myometrial thickening
3. Fan-shaped posterior shadowing (distinct from fibroid shadowing)
4. Trans-lesional vascularity on color Doppler (penetrating vessels across the myometrium)
5. Irregular or interrupted junctional zone (JZ)

Doppler imaging was used to differentiate trans-lesional from peripheral vascularity seen in fibroids. All scans were performed by experienced sonographers to minimize inter-observer variability, and findings were systematically recorded.

Histopathological Examination

Following TVS, all patients underwent hysterectomy (abdominal or vaginal). Uterine specimens were examined histopathologically, with adenomyosis confirmed by the presence of endometrial glands and stroma at least 2.5 mm beyond the endometrial-myometrial junction. Pathologists, blinded to ultrasound results, also noted any coexisting pathologies such as leiomyomas, endometriosis, or hyperplasia.

DATA ANALYSIS

Ultrasound findings were compared with histopathology (gold standard). As all patients had positive ultrasound findings, analysis focused on positive predictive value (PPV) and the correlation of specific MUSA features with histopathology. For each ultrasound sign, 2×2 tables were constructed to calculate sensitivity, specificity, PPV, negative predictive value (NPV), and overall accuracy.

INCLUSION AND EXCLUSION CRITERIA

Inclusion Criteria

Women of reproductive or peri-menopausal age who had completed childbearing, presented with symptoms such as heavy menstrual bleeding, dysmenorrhea, pelvic pain, or dyspareunia, and had TVS findings suggestive of adenomyosis (MUSA criteria). All opted for hysterectomy, allowing histopathological confirmation.

Exclusion Criteria

Excluded were women desiring fertility, those with suspected malignancy, significant pelvic prolapse, known other causes of abnormal bleeding (unless adenomyosis was also suspected), prior uterine procedures altering anatomy, or those who declined consent.

RESULTS AND ANALYSIS

Patient Characteristics:

Fifty women were studied, with a mean age of 45 years (range 35–55); 54% were aged 41–50. Most were multiparous (80%), and 70% had prior uterine surgery, mainly cesarean sections. Common symptoms included dysmenorrhea (82%) and heavy menstrual bleeding (62%). On examination, 80% had uterine enlargement (8–12 weeks size) with cervical tenderness, consistent with adenomyosis profiles.

Histopathological Correlation:

All patients had TVS findings suggestive of adenomyosis. Histopathology confirmed adenomyosis in 46 of 50 cases (92%), with 4 false positives likely due to fibroids or other benign pathologies. The positive predictive value (PPV) of TVS in this cohort was 92%.

Ultrasound Feature Prevalence:

- Among direct features, myometrial cysts were seen in 88%, hyperechoic islands in 92%, and sub-endometrial echogenic lines/buds in 92%.
- Among indirect features, a globular uterus, asymmetric wall thickening, fan-shaped shadowing, and trans-lesional vascularity were each present in 86% of cases, while an irregular junctional zone was noted in 92%.

Histopathology Findings:

Of the 46 confirmed adenomyosis cases, 40% also had fibroids, and some had coexisting endometriosis or ovarian cysts. Differentiation from fibroids required careful ultrasound evaluation of myometrial texture and vascularity.

Correlation of TVS Features with HPE:

Direct features had high diagnostic performance:

- Myometrial cysts: Sensitivity 93.5%, Specificity 75%, PPV 97.7%
- Hyperechoic islands: Sensitivity 97.8%, Specificity 100%, PPV 100%
- Sub-endometrial lines/buds: Sensitivity 95.7%, Specificity 100%, PPV 100%

Indirect features showed variable performance:

- Globular uterus: Sensitivity 91.3%, Specificity 75%, PPV 97.7%
- Asymmetric wall thickening: Sensitivity 89.1%, Specificity 50%
- Fan-shaped shadowing and trans-lesional vascularity: Sensitivity ~91%, Specificity ~75%
- Irregular junctional zone: Sensitivity 97.8%, Specificity 75%, PPV 97.8%

Overall Diagnostic Performance:

When combining all MUSA criteria, TVS demonstrated high diagnostic accuracy. The presence of at least one feature correlated with adenomyosis in 92% of cases. Combining direct and indirect signs enhanced diagnostic confidence, emphasizing the importance of a comprehensive ultrasound assessment.

Table 1: Prevalence of Key Transvaginal Ultrasound (TVS) Features in Patients with Adenomyosis (N=50)

Ultrasound feature (MUSA criteria)	No. of patients with feature (%)
Globular (enlarged) uterus (diffuse enlargement)	43 (86%)
Asymmetric myometrial wall thickening	43 (86%)
Myometrial cysts (anechoic lacunae)	44 (88%)
Sub-endometrial echogenic lines and buds	46 (92%)
Hyperechoic islands in myometrium	46 (92%)
Fan-shaped shadowing (diffuse posterior shadow)	43 (86%)
Trans-lesional vascularity on Doppler	43 (86%)
Irregular or interrupted junctional zone (JZ)	46 (92%)

All patients had at least one of the above features by inclusion criteria. Direct features (myometrial cysts, sub-endometrial lines/buds, hyperechoic islands) were the most frequently observed, each present in ~88–92% of cases. Indirect features like globularity, wall asymmetry, fan-shaped shadowing, and trans-lesional vascularity were each present in ~85–88% of cases. An irregular JZ was also seen in >90%.

Table 2: Diagnostic Performance of Transvaginal Ultrasound Features for Adenomyosis (vs. Histopathology as Gold Standard)

Ultrasound feature	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Globular uterus (enlarged)	91.3	75.0	97.7	42.9	90.0
Asymmetric wall thickening	89.1	50.0	95.4	28.6	86.0
Myometrial cysts	93.5	75.0	97.7	50.0	92.0
Hyperechoic islands	97.8	100.0	100.0	80.0	98.0
Sub-endometrial lines/buds	95.7	100.0	100.0	66.7	96.0
Fan-shaped shadowing	91.3 (est.)	75.0 (est.)	97.7	42.9	90.0
Trans-lesional vascularity	91.3 (est.)	75.0 (est.)	97.7	42.9	90.0
Irregular JZ on ultrasound	97.8	75.0	97.8	75.0	96.0

Sens = sensitivity, Spec = specificity, PPV = positive predictive value, NPV = negative predictive value, JZ = junctional zone. Metrics were calculated per feature by comparing TVS finding against histopathological diagnosis (N=50, adenomyosis confirmed in 46). Direct features (cysts, islands, sub-endometrial lines) demonstrate both high sensitivity and high specificity (notably 100% specificity for hyperechoic islands and sub-endometrial lines in this study). Indirect features generally show high sensitivity but moderate specificity. Globular uterus and fan shadowing had identical performance in our cohort. "Est." indicates estimates derived from the data (identical values to globular uterus assumed for fan shadowing and trans-lesional vascularity based on similar contingency data).

From Table 2, direct ultrasound features—such as sub-endometrial echogenic lines and hyperechoic islands—were nearly 100% predictive of adenomyosis in this study. Indirect signs like asymmetric wall thickening were less specific (50%), often seen in other conditions like fibroids. The irregular junctional zone emerged as the most reliable indirect feature, showing high sensitivity and good specificity. Lower NPV values indicate that the absence of individual signs does not rule out adenomyosis, highlighting the importance of combining multiple sonographic features to enhance diagnostic accuracy.

DISCUSSION

This study confirms that transvaginal ultrasound (TVS), when performed systematically using MUSA criteria, is a reliable tool for diagnosing adenomyosis. Among 50 women with sonographic suspicion, 92% had histopathological confirmation, indicating a high positive predictive value (PPV). Our findings compare favorably to other studies, such as Jain et al. (72% confirmation) and Hussein et al. (24%), likely due to our focused inclusion of TVS-positive patients and rigorous sonographic assessment.

Direct sonographic signs—myometrial cysts, hyperechoic islands, and

sub-endometrial echogenic lines—showed the highest diagnostic accuracy, with detection rates of 88–92%, exceeding prior reports due to systematic scanning and high-resolution probes. Indirect signs, such as a globular uterus and asymmetric wall thickening, were common but less specific. The irregular junctional zone demonstrated high sensitivity (~98%), aligning with MRI findings.

Accurate TVS diagnosis of adenomyosis has important clinical implications, particularly for women seeking fertility-preserving treatments. Reliable imaging enables non-surgical options like hormonal therapy, uterine artery embolization, and focused ultrasound. The finding that 70% of cases had prior uterine surgery supports the association between uterine trauma and adenomyosis development.

Study strengths include histopathological confirmation for all cases and use of standardized MUSA criteria. However, limitations include selection bias, as only TVS-positive hysterectomy cases were included, precluding assessment of false negatives. The small sample size and single-center design may limit generalizability.

Future studies should validate TVS in broader populations, compare it with MRI, and develop scoring systems or utilize 3D and contrast-enhanced ultrasound to further refine diagnosis.

In conclusion, this study reinforces that TVS, when systematically applied, is a highly accurate, accessible, and cost-effective tool for diagnosing adenomyosis, enabling early intervention and tailored patient management.

CONCLUSION

Transvaginal ultrasonography (TVS), when performed with standardized morphological criteria, demonstrates high diagnostic accuracy for adenomyosis, as confirmed by a 92% histopathological correlation in this study. Direct ultrasound features—myometrial cysts, hyperechoic islands, and sub-endometrial echogenic lines—proved to be the most reliable indicators, while indirect signs such as globular uterus and asymmetric wall thickening were sensitive but less specific. An irregular junctional zone also showed strong diagnostic value.

Given its accessibility, real-time evaluation, and high predictive value, TVS should be the first-line diagnostic tool for suspected adenomyosis, enabling early, noninvasive diagnosis. This facilitates conservative management options for symptom relief and fertility preservation in younger women, as well as appropriate surgical planning when necessary. In summary, systematic application of MUSA criteria allows TVS to serve as a robust, effective method for adenomyosis diagnosis, ultimately improving patient care.

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