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Diagnosis of Uterine Adenomyosis Using Transvaginal Sonography and Histopathological Analysis

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Abstract

Adenomyosis is a benign uterine disorder that is common but often overlooked, defined by the presence of endometrial glands and stroma in mural myometrium. Clinically, these lesions are frequently related with abnormal uterine bleeding, dysmenorrhoea, pelvic pain and subfertility and are a significant cause of morbidity in premenopausal women. With the development of imaging techniques, non-invasive diagnostic methods such as transvaginal sonography (TVS) have come to be of clinical relevance, especially in resource-poor settings, TVS could be a feasible alternative to magnetic resonance imaging (MRI) scans for initial assessment of uterine adenomyosis. A cross-sectional study was carried out at Department of Radiology & Imaging, Community Based Medical College, Bangladesh (CBMC,B) Hospital, Mymensingh, Bangladesh, between July 2022 and June 2023, to evaluate diagnosis of uterine adenomyosis by transvaginal sonography comparing to histopathological findings. A total of 43 women, aged between 30 and 45 years, clinically suspected cases of uterine adenomyosis were included in the study. All patients had TVS examination performed by experienced radiologists and a post-hysterectomy histopathological testing of the surgical specimens. We calculated sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), i.e., diagnostic accuracy of TVS against histopathology (taken as the gold standard). TVS identified adenomyosis in 35 patients, while histopathology confirmed adenomyosis in 34 cases. Of these, there was one false positive, two false negatives, and six true negatives. The diagnostic performance of TVS was remarkable, showing a sensitivity of 94.4%, specificity of 85.7%, PPV of 97.1%, NPV of 75%, and overall accuracy of 93%. Other uterine pathologies identified included fibroids (n=4), bulky uterus (n=2), and endometrial polyps (n=2). Our data suggests that TVS has a higher frational precison for the forecasting the diagnosis of uterine adenomyosis. In low- and middle-income countries, where MRI scans are expensive and not easily accessible, TVS should be regarded as the most preferred diagnostic investigation for adenomyosis.

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Introduction

Adenomyosis is a common, benign gynecological disorder in which endometrial glands and stroma are present within the myometrium causing hypertrophy and hyperplasia of adjacent smooth muscle bundles. Traditionally thought to be a disease of multiparous women in their fourth and fiftieth decades, adenomyosis is more and more diagnosed in the younger population as well, frequently with a history of abnormal uterine bleeding, dysmenorrhea, pelvic pain and infertility.[1-3] The disease severely impacts the quality of life presenting chronic pain, anaemia and reproductive problems resulting in a considerable socioeconomic, physical and emotional burden for affected women.[2] Although common, adenomyosis is still underdiagnosed in clinical practice because of its nonspecific symptoms and overlap with other uterine diseases, such as leiomyoma and endometrial

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polyps.[3-5] In the past, the gold standard for diagnosis of adenomyosis has been histopathological study of hysterectomy specimens.[1,2] This dependence on postoperative histological analysis has impeded early diagnosis and management of the disease, most notably in women wishing to preserve fertility.[6,7] Improved imaging modalities such as transvaginal sonography (TVS) and magnetic resonance imaging (MRI) are non-invasive imaging methods.[8-11] TVS is most commonly used over other expensive imaging tools because of its cost-effectiveness, availability and its capability to obtain high-resolution images of the uterus facilitating assessment of findings such as myometrial heterogeneity (Quartier), asymmetric thickening, myometrial cysts and indistinct endometrial-myometrial junctions.[10,11] Although MRI is currently the most accurate non-invasive radiologic modality for diagnosing adenomyosis, it is expensive, not widely available in resource-constrained areas, and not applicable for routine clinical practice in many developing countries.[9,10] This restriction highlights the necessity to estimate the diagnostic performance of TVS as an effective substitute for ademoysis detection. Sensitivity and specificity of the TVS have been inconsistently reported, which in many situations seem to rely on a number of factors including operator experience and criteria for diagnosis.[11] It is now imperative to correlate the sonographic findings of TVS with histopathological confirmation, so that clinicians can make evidence based clinical decisions in their local healthcare environment. In Bangladesh, gynecological problems particularly abnormal uterine bleeding and chronic pelvic pain are leading cause of hospital visit, in which many undergo hysterectomy as a definitive management.[12,13] Indeed, in such clinical scenario the value of TVS as a diagnostic tool for adenomyosis is particularly noteworthy, as TVS findings will be compared with histopathological confirmation to determine the actual diagnostic value of sonography and its ability to prevent unnecessary surgery.[14] In addition, knowledge of diagnostic accuracy of TVS is essential for improved patient counselling and earlier intervention, especially regarding fertility-sparing treatment approaches where possible. The current research, therefore, was designed systematically to assess the diagnostic accuracy of TVS for detecting adenomyosis (correlating with histopathology) among Bangladeshi women.

Methods

This cross-sectional study was carried out at Department of Radiology & Imaging, Community Based Medical College, Bangladesh (CBMC,B) Hospital, Mymensingh, Bangladesh, between July 2022 and June 2023. The study population included women from 30 to 45 years who were referred for clinical suspicion of adenomyosis, mostly related to abnormal uterine bleeding (AUB), dysmenorrhea and chronic pelvic pain. These patients were secondarily selected after a primary gynecologist evaluation and were sent for the TVS as part of their diagnostic process. The aim of this study was to evaluate the diagnostic accuracy of TVS by comparing its results with histopathological reports performed after hysterectomy, considered as a gold standard for confirming diagnosis. The study was approved by the institutional review board and consent was obtained from all participants prior to their inclusion in the study.

Our inclusion and exclusion criteria were stringent, in order to maintain standardized diagnostic evaluation. Inclusion criteria were: i) women aged 30–45 years, and ii) patients with clinical presentations consistent with adenomyosis such as menorrhagia,

dysmenorrhea or pelvic pain and consented to be examined through both transvaginal sonography and hysterectomy. Exclusion criteria were: i) patients with refusing TVS examination, ii) patients who refused surgery; iii) cases with missing or incomplete histopathological results, and iv) contraindications for transvaginal ultrasound. Through utilizing these standards, we reduced the bias and excluded those non-eligible cases.

TVS studies were performed by experienced radiologists with the high-frequency (5–7.5 MHz) transvaginal probes. Uterus was evaluated in detail longitudinally and transversely to analyze myometrial echotexture, presence of cysts within the myometrium, asymmetrical wall thickening, ill-defined endometrial–myometrial junction, and uterine enlargement. Signs were considered suggestive of adenomyosis, if at least 2 characteristic features were detected (Fig. 1 & 2). Also, incidental findings of a fibroid, bulky uterus or endometrial polyp were noted. After sonographic examination, hysterectomy was performed for all patients and uterine specimens were sent to the pathology department for extensive histopathologic study. Histological features of adenomyosis were endometrial glands and stroma in the myometrium encased by hypertrophied smooth muscle fibers (Fig. 3).

Data was entered into a structured database and analyzed using IBM SPSS Statistics for Windows, version 25 (IBM Corp., Armonk, NY, USA). Demographic data and clinical presentation were summarized using descriptive statistics. A 2×2 contingency table was analyzed to correlate TVS results with histopathologic ones, sensitivity, specificity, PPV, NPV and overall accuracy were calculated. Continuous variables were described as meanSD, whereas categorical variables were reported as frequency and percentage. Descriptive analyses with frequencies and percentages were displayed with tables, as well as a bar graph for TVS findings distribution, and a pie graph for histopathological outcomes. This analysis helped in evaluating the diagnostic utility of TVS in an unbiased manner and identified agreement and disagreement with histopathology.

The study was approved by the Ethical Review Committee of Community Based Medical College, Bangladesh (CBMC,B), Mymensingh, Bangladesh.

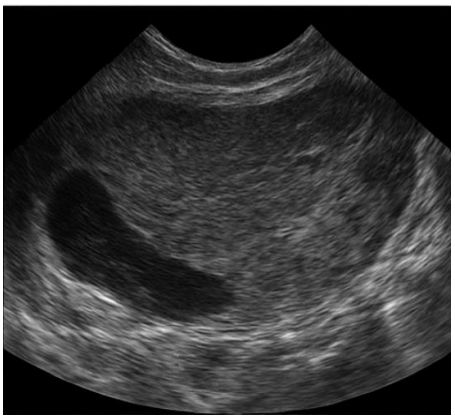

Fig. 1: Transvaginal sonography showing adenomyosis with heterogeneous myometrium and asymmetry.

Fig. 2: Transvaginal sonography showing myometrial cysts characteristic of adenomyosis.

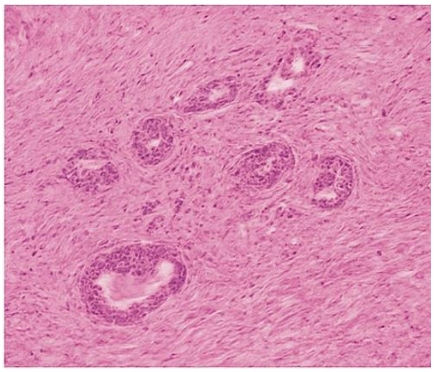

Fig. 3: Histopathology slide demonstrating ectopic endometrial glands in the myometrium (H&E stain; ×40)

Results

In total, 43 women aged between 30 and 45 years participated in the study. Among clinical features, menorrhagia was observed in 28 (65.1%), while dysmenorrhoea in 24(55.8), and chronic pelvic pain in 18 (41.9) (Table-I). Adenomyosis was diagnosed through TVS in 35(81.40%) patients, while fibroids were found in 4(9.30%), bulky uterus in 2(4.65%) and endometrial polyps in 2(4.65%) cases. After histopathological examination, adenomyosis was diagnosed in 34(79.07%), 5(11.63%) were fibroids, 2(4.65%) were bulky uterus and 2(4.65%) were endometrial polyps (Table-II). However, in histological examination, for adenomyosis, true positive histopathology was found in 34 patients (79.1%), and there was 1 false positive case (2.3%), which was later diagnosed as fibroid. There were 2 false-negative cases (4.7%), where TVS could not identify those as adenomyosis. The 6 others who were negative for adenomyosis at TVS and on histopathology were true-negative (14.0%) (Fig. 4). The sensitivity of TVS for diagnosis of adenomyosis was 94.4%, which means it could correctly identified most cases of adenomyosis in this cohort. The specificity was found 85.7% indicating a good power to exclude adenomyosis in women who do not have the disease. The positive predictive value (PPV) was quite high with 97.1% indicating that almost all patients detected as adenomyosis through TVS were true-positive on histopathology. The negative predictive value (NPV) was 75% indicating that a negative sonographic finding did not exclude adenomyosis. The total diagnostic accuracy of TVS was estimated 93%, which confirmed the potential value of a highly accurate diagnostic modality in such clinical scenario (Table-III).

Table-I: Demographic and clinical profile of the patients (n=43)

Variables	**Frequency (Percentage)**
Age group	
30–34 years	12 (27.9)
35–39 years	16 (37.2)
40–45 years	15 (34.9)
Clinical features	
Menorrhagia	28 (65.1)
Dysmenorrhoea	24 (55.8)
Chronic pelvic pain	18 (41.9)

Table-II: Comparison of transvaginal sonography (TVS) results with histopatholgy examination (n=43)

Pathology	**TVS Frequency (Percentage)**	**Histopathology Frequency (Percentage)**
Adenomyosis	35 (81.40)	34 (79.07)
Fibroid	4 (9.30)	5 (11.63)
Bulky uterus	2 (4.65)	2 (4.65)
Endometrial polyp	2 (4.65)	2 (4.65)

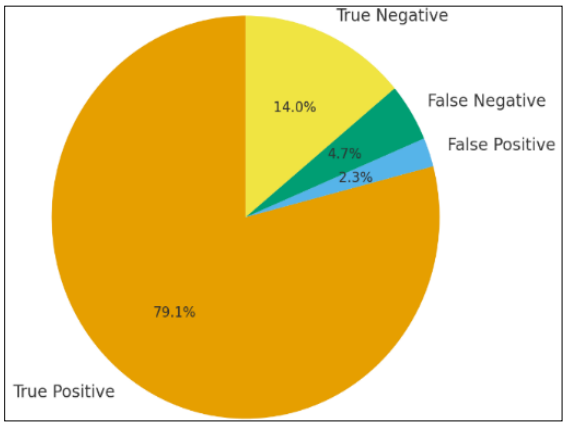

Fig. 4: Histopathology outcomes on diagnosis by TVS.

Table-III: Diagnostic performance metrics

Metrics	Value
Sensitivity	94.44%
Specificity	85.71%
PPV	97.14%
NPV	75%
Accuracy	93.02%

Discussion

In the present study, TVS was an accurate imaging modality for the diagnosis of uterine adenomyosis with 94.4% sensitivity, 85.7% specificity, PPV and NPV 97.1% and 75%, respectively and overall accuracy of 93%. These diagnostic indices support the use of TVS as a primary modality in women with symptomatic abnormal bleeding, dysmenorrhea, or chronic pelvic pain. Similar findings have been reported in previous investigations, that is sensitivities ranging from 80 to 90% and specificities between 70% and 85%, suggesting the reproducibility of TVS measurements in different populations.[8-11] The high PPV in our study indicates the reliability of TVS to diagnose adenomyosis once sonographic hallmarks as myometrial heterogeneity, asymmetrical wall thickening or myometrial cysts are present. Nevertheless, the low NPV means a negative scan cannot safely exclude adenomyosis, which is consistent with results from previous studies,[8,9] a deep adenomyosis may be is occult to ultrasound due to its reduced tissue penetration and operator-dependent characteristics.[11] This indicates that while TVS is good at detecting adenomyosis if present, caution ought to be exercised in the interpretation of normal results, particularly in symptomatic women.Compared to MRI, TVS is less precise but highly applicable in gynecological daily practice. MRI scans are commonly regarded as the non-invasive gold standard of adenomyosis because it allows accurate depiction of the junctional zone and detailed visualization of uterine anatomy.[4,11,14] However, high cost, limited availability and technical demand. exclude its utility in low- and middle-income countries.[12] In comparison, TVS is less expensive, portable and ubiquitously available without compromising quality of images on monitors. Several studies supported this perspective that TSV had a sensitivity and specificity similar to MRI when performed by experienced sonographers.[8-11]

Although we used only standard two-dimensional TVS, our diagnostic parameters resemble closely the diagnostic indications obtained by more complex methods, which underline the usefulness of TVS as a standalone examination, minimizing further expenses for additional modalities.These findings have important clinical implications, particularly in countries with limited resources such as Bangladesh. TVS allows preoperative diagnosis, appropriate patient counseling and planning of definitive surgery as well as a conservative approach in women desiring

preservation of fertility.[2,12,13] In this group, adenomyosis was most prevalent in women in their late 30s to early 40s as reported globally.[15,16] Significantly, our study also observed the cases of concomitant uterine pathologies such as fibroids and polyps which tends to raise the challenge of ultrasonography. Specifically, distinguishing adenomyosis from leiomyomas is difficult due to its similar presentation of uterine enlargement as well as heterogeneous echotexture and overlapping clinical symptoms.[11,14] This overlap would also plausibly account for the one false-positive case in our study, which is consistent with previous reports, as they demonstrated the inability of TVS to differentiate between both conditions.[11,14] In a bilateral setting as in our series, these two false negative cases also highlight the necessity of having a clinical suspicion even though TVS findings are indeterminate.[10,11] In many cases other imaging modalities, such as MRI scans, might be saved for equivocal presentations given financial and infrastructure constraints that usually do not allow for their routine use.[12,13] Moreover, from a public health standpoint, the possibility of depending on TVS as an economical diagnostic technique has great relevance to women´s reproductive health in developing countries like Bangladesh, where rates of hysterectomy are still high because patients seek medical assistance late, and conservative treatment is scarce.[12,13]

Our study has several limitations. First, the number of patients was small and all were from one tertiary care hospital, which might not be generalizable to a larger population. Large, multicenter studies would offer stronger evidence. Secondly, TVS is a operator-dependent approach and its diagnostic accuracy may differ depending on the experience or proficiency of the attending radiologist, all scans in the present study were carried out by experienced radiologists though. Thirdly, the study population included women who had hysterectomy performed, which introduced selection bias and failed to cover mild cases or those managed conservatively. This may possibly result in overestimation of the diagnostic accuracy because advanced cases are easier to diagnose. Furthermore, we did not directly compare TVS with MRI which is considered the imaging gold standard in diagnosing adenomyosis. This would have allowed a more complete comparison of the pros and cons of TVS. Lastly, histopathological analysis was only available on post-hysterectomy specimens; hence, our results may not be generalizable to women who desire fertility preservation.

Conclusion

Based on the results of this study, TVS can be reliably employed as a readily available diagnostic modality in adenomyosis. The sensitivity, specificity, PPV, NPV and overall accuracy of TVS for the detection of endometrial pathology were estimated 94.4%, 85.7%, 97.1% and 75% and 93% respectively, with good concordance between findings on TVS and histology (gold standard). The high positive predictive value demonstrates that adenomyosis diagnosed with TVS is almost invariably confirmed histologically and is an indispensable preoperative aid. Moreover, the demonstration of co-existent uterine pathologies such as fibroids and endometrial polyps adds to an overall diagnostic profile that is highly useful in planning of surgery. Significantly, the study also emphasizes that although false negatives continue to be an impediment, TVS should remain as first line modality of choice considering its ready availability, inexpensiveness, and non-invasiveness.

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