ORIGINAL ARTICLE

ROLE OF TRANSVAGINAL SONOGRAPHY IN DIAGNOSING ADENOMYOSIS AND ITS CORRELATION WITH HISTOPATHOLOGY

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ABSTRACT

Background: Adenomyosis represents a prevalent pathological condition within the field of gynecology, characterized by the aberrant proliferation of endometrial tissue within the myometrium of the uterus. Despite the diagnostic challenges associated with adenomyosis, this investigation underscores the significance of transvaginal sonography as a primary diagnostic modality within the context of the patient's gynecological assessment.

Objectives: To find the role of transvaginal sonography in diagnosing adenomyosis and its correlation with histopathology.

Methods: This cross-sectional study was carried out within the Department of Gynaecology at Liaquat National Hospital, Karachi. The total sample size comprised of 275 patients. Adenomyosis was operationally defined as the presence of endometrial glands and stroma that infiltrated the myometrium, accompanied by both hypertrophy and hyperplasia of the myometrial tissue. Descriptive statistical analyses were performed. Student's t-test was used to assess quantitative variables, whereas Chi-square test was utilized for qualitative variables. For ultrasound findings that correlated with ultimate histological diagnosis, sensitivity, specificity, negative predictive values, positive predictive values, and overall accuracy were meticulously calculated.

Results: The mean age was 44.68±2.71 years. There were 20.4% females found with myometrial cyst, all had heterogenous myometrium, 10.5% had globular configuration, 86.9% had asymmetric antero-posterior uterine wall, 47.6% with sub-endometrial echogenic junctions and 90.2% with Identification of endo-myometrial junctions. We found 76.7% patients with adenomyosis by transvaginal sonography (TVS) and 80% by histopathology. Sensitivity, Specificity, PPV, NPV and accuracy were 95.9%, 100%, 100%, 85.90%, and 96.72% respectively.

Conclusion: It can be concluded that adenomyosis may be identified with a significant degree of precision through the utilization of transvaginal ultrasound.

Key Words: Adenomyosis, Histopathological Findings, Transvaginal Sonography

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Introduction

Adenomyosis has historically been regarded as a pathology predominantly affecting multiparous females in the later stages of their reproductive lifespan.[1] Typically identified subsequent to the performance of hysterectomies.[2] Adenomyosis represents a prevalent pathological condition within the field of gynecology, characterized by the aberrant proliferation of endometrial tissue within the myometrial layer of the uterus. This condition manifests as a consequence of the perturbation of the normal demarcation between the basal layer of the endometrium and the myometrium.[3-6] The etiology of this disturbance remains inadequately elucidated; however, it could potentially be attributable to uterine trauma, gestation-related factors, postpartum endometritis, or cesarean section procedures.[3]

It has garnered significant global attention due to its characterization as a complex disease identified through noninvasive imaging methodologies in young females.[7] presenting with abnormal uterine bleeding (AUB), infertility, and pelvic discomfort, as well as in asymptomatic individuals.[8] Furthermore, adenomyosis is frequently identified concurrently with gynecological comorbid conditions including endometriosis.[9,10] and uterine fibroids.[11]

The formulation of a diagnosis predicated on clinical observations is often a complex endeavor due to the vague characteristics of the symptoms and the common occurrence of concurrent pelvic pathologies.[12] Until the recent past, the identification of the condition was predominantly confirmed through biopsy or surgical intervention.[13] However, with the emergence of advanced high-resolution imaging methodologies, accurate diagnosis can now be achieved utilizing imaging techniques.[14]

The preliminary histopathological observation associated with this condition has been designated as osteosarcoma adenoids uterinum.[15] Nonetheless, a majority of individuals diagnosed with adenomyosis remain asymptomatic. It has been documented that dysmenorrhea, excessive vaginal hemorrhage during menstruation, and pelvic discomfort constitute the prevalent presenting symptoms.[16] Recent empirical findings indicate that the incidence of adenomyosis ranges from approximately 10% to 31%.[17,18] Another investigation revealed that the occurrence of adenomyosis was observed in 20.9% of the studied population.[19] In the context of the Pakistani demographic, adenomyosis was identified in 68.3% of patients.[20] A hypothesis regarding the alteration of lymphatic pathways has been proposed to elucidate the pathogenesis of adenomyosis.[21]

When evaluating adenomyosis, typical techniques such as ultrasound, hysterosalpingography, and magnetic resonance imaging (MRI) are applied. A minimally invasive diagnostic method called hemerosalpingography entails a risk of radiation exposure.[22] Since TVS is more practical and has a higher frequency that may enhance spatial resolution while accurately detecting adenomyosis, it is a better choice. Additionally, TVS is far less expensive than MRI and is often easier for most practicing gynecologists to access in the office; nonetheless, its ability to characterize tissue is limited. Another reliable noninvasive method for detecting adenomyosis is magnetic resonance imaging (MRI). Understanding the specifics of the disease's histopathologic foundation is beneficial in comprehending the nature of adenomyosis and its clinical and sonographic presentation.[23] A normal enlarged uterus with potential myometrial asymmetry unrelated to leiomyoma was classified as a globular and/or asymmetric uterus. These were the diagnostic criteria for adenomyosis by TVS.[12]

According to studies, women with diffuse adenomyosis may be accurately diagnosed with imaging techniques such magnetic resonance imaging and two- and three-dimensional transvaginal ultrasounds (2D and 3D TVUS) with sensitivity of 80–86% and 50–96%, respectively.[24, 25] Nonetheless, few research has examined the first phases of adenomyosis, in which individuals with localized adenomyosis and little to no symptoms are detected.[26-29] Consequently, there is still a paucity of clinical criteria and common imaging criteria, and the evidence from earlier research is inconsistent and not entirely comparable.[30] Even after histological inspection, it is crucial to keep in mind that disagreements regarding pathogenic hypotheses, classifications, and diagnostic imaging standards hinder the agreement upon a common description of adenomyosis.[31]

A myometrial region that was poorly defined and had either increased or reduced echogenicity was considered to be a heterogeneous myometrium. Radiate pattern of thin acoustic shadowing not originating from echogenic foci and/or leiomyoma was the definition of myometrial hypoechoic linear striations.[32] A spherical, anechoic region with a diameter of 1–7 mm was designated as a metazoan cyst. If at least one of the aforementioned requirements was satisfied, the diagnosis was made.[33] Although the diagnostic process of adenomyosis is currently challenging, this study, given the importance of TVUS as a first-line diagnostic examination in the patient's gynecological investigations, aims to contribute by evaluating the association of 2D and 3D TVUS findings with adenomyosis symptoms.

Given the significance of TVUS as a first-line diagnostic examination in the patient's gynecological investigation, this study aims to contribute by evaluating the association between 2D and 3D TVUS findings and adenomyosis symptoms, despite the fact that the diagnosis process of adenomyosis is currently challenging.

Methods

This prospective cross-sectional study was conducted at the Department of Gynaecology, Liaquat National Hospital, Karachi. Permission from Liaquat National Hospital's Research and Ethical Review Committee Ref: App#0823-2022-LNH-ERC was taken before commencement of the study. Patients who visited department of Gynaecology and met the inclusion criteria were enrolled in the study after their informed consent. Sample size was calculated using Open Epi software. The sample size calculated for this study was 275 patients using frequency of 23.3%[34] of patients with adenomyosis diagnosed by transvaginal ultrasonography. Women with age 18-50 years with abnormal uterine bleeding, pelvic pain, and infertility were included in the study. Pregnant women, with cervical cancer, and with current use of hormonal treatment were excluded from this study. The adenomyosis was defined by the presence of endometrial glands and stroma deep into the myometrium, as well as hypertrophy and hyperplasia of the myometrium.[35]

Patient's data were compiled and analyzed through Statistical Package for Social Sciences (SPSS) version 25. The results were expressed as mean & standard deviation for quantitative variables and frequency/proportion with percentages were reported for qualitative variables. Student's t-tests were used for quantitative variables; while Chi-square test, was used for qualitative variables. For ultrasound observations that corresponded to the final histological diagnosis, sensitivity, specificity, negative predictive values, positive predictive values and accuracy were calculated. The P value ≤ 0.05 was taken as statistically significant. Confidentiality of the patients was ensured throughout the study and their medical record was tagged with coded serial number to hide their identity. Confounding variables and biasness were controlled by strictly following stratification and inclusion criteria.

Results

The study included 275 participants with a mean age of 44.68±2.71 years. Among the study population, 164 (59.6%) were aged ≤45 years, and 111 (40.4%) were older than 45 years. A majority of participants were not overweight (70.5%), while 29.5% were classified as overweight. Myometrial cysts were observed in 56 participants (20.4%), and all participants (100%) exhibited a heterogeneous myometrium. Globular uterine configuration was identified in 29 participants (10.5%), whereas the remaining 246 (89.5%) had no globular changes. Asymmetric anterior-posterior uterine wall thickening was found in 239 participants (86.9%), with 131 (47.6%) showing sub-endometrial echogenic junctions. The endo-myometrial junction was identified in 248 participants (90.2%), and transvaginal sonography (TVS) confirmed adenomyosis in 211 participants (76.7%). Histopathology confirmed adenomyosis in 220 participants (80%). TVS findings of adenomyosis were significantly associated with several factors. Age group >45 years (p=0.023), globular uterine configuration (p=0.002), sub-endometrial echogenic junctions (p=0.001), and identification of the endo-myometrial junction (p=0.000) were statistically significant predictors. However, other variables such as overweight status (p=0.790), presence of myometrial cysts (p=0.153), and asymmetric uterine wall thickening (p=0.792) did not show significant associations with TVS-confirmed adenomyosis. The diagnostic accuracy of TVS in detecting adenomyosis was impressive, with a sensitivity of 95.9%, specificity of 100%, positive predictive value (PPV) of 100%, negative predictive value (NPV) of 85.9%, and an overall accuracy of 96.72% compared to histopathological findings.

Table I: Descriptive statistics of the included population

Age (years)	
Mean±Std. Dev	44.68±2.71
Group	
≤45 years	164 (59.6%)
>45 years	111 (40.4%)
Overweight	
Yes	81 (29.5%)
No	194 (70.5%)
Myometrial Cyst	
Yes	56 (20.4%)
No	219 (79.6%)
Heterogenous Myometrium	
Yes	275 (100%)
No	0 (0)
Globular Configuration	
Yes	29 (10.5%)
No	246 (89.5%)
Asymmetric Antreo-Posterior Uterine Wall	
Yes	239 (86.9%)
No	36 (13.1%)
Sub-Endometrial Echogenic Junctions	
Yes	131 (47.6%)
No	144 (52.4%)
Identification Of Endo-Myometrial Junctions	
Yes	248 (90.2%)
No	27 (9.8%)
TVS Confirmed Adenomyosis	
Yes	211 (76.7%)
No	64 (23.3%)
Histopathological Confirmed Adenomyosis	
Yes	220 (80%)
No	55 (20%)

Table II: Association of TVS confirmed adenomyosis

Age Group			
	≤45 Years	118 (55.9)	0.023*
	>45 Years	93 (44.1)	
Overweight			
	Yes	63 (29.9)	0.790
	No	148 (70.1)	
Myometrial Cyst			
	Yes	47 (22.3)	0.153
	No	164 (77.7)	
Globular Configuration			
	Yes	29 (13.7)	0.002*
	No	182 (86.3)	

Asymmetric Antreo-Posterior Uterine Wall			
	Yes	184 (87.2)	0.792
	No	27 (12.8)	
Sub-Endometrial Echogenic Junctions			
	Yes	112 (53.1)	0.001*
	No	99 (46.9)	
Identification of Endo-Myometrial Junctions			
	Yes	202 (95.7)	0.000*
	No	9 (4.3)	

Chi-square/fisher exact test was applied.
*Significant at 0.05 level.

Table III; Association of histopathology confirmed adenomyosis with TVS confirmed adenomyosis

TVS Confirmed Adenomyosis	Histopathological Confirmed Adenomyosis		P-value	Sensitivity	Specificity	PPV	NPV	Accuracy
	Yes	No						
Yes	211	0	0.000*	95.9%	100%	100%	85.90%	96.72%
No	9	55						

Chi-square/fisher exact test was applied.
*Significant at 0.05 level.

Discussion

One of the most prevalent uterine conditions found during the histological analysis of hysterectomy tissues is adenomyosis. Between 5 and 70% of cases are documented, which is a large range.[12,13] This broad variation might be caused by variations in the histological criteria used to diagnose adenomyosis, the level of caution used when examining pathological specimens, or the quantity of sample sites that were taken into account in earlier research.[36] Because sonography is widely available and non-invasive, it has become a key favored technique in the diagnostic workup of adenomyosis.[3]

Our results, first and foremost, highlight the significance of ruling out adenomyosis as a possible diagnosis in women presenting with symptoms like pelvic discomfort and dysmenorrhea, particularly in those who belong to the identified at-risk demographic categories. Healthcare professionals need to understand the value of sonography as an accessible and non-invasive adenomyosis diagnosis tool. Moreover, our reported diagnostic accuracy values emphasize the usefulness of sonography in the preliminary evaluation of adenomyosis. Patients can be categorized using this imaging modality to help with future assessment and therapy planning.

According to published reports, the increasing cost of MRI and the general accessibility of ultrasound have led to TVS being preferred as the primary imaging modality for preliminary evaluations, while MRI is now only used for non-invasive diagnosis in cases where the diagnosis is unclear or uncertain.[37-39] According to research by Ara H. et al., TVS had an overall diagnostic accuracy of 85.00%, sensitivity of 89.20%, specificity of 77.88%, PPV of 87.22%, and NPV of 81.00% in the detection of adenomyosis.[3] These results indicate that sonography has the potential to be a useful diagnostic tool for adenomyosis, with a respectable specificity for confirming the condition's presence and a relatively high sensitivity for ruling it out. This result is in line with other research that found that the diagnostic accuracy criteria were substantially comparable.[40-42]

In contrast to the results of the Ara H et al. study, a recent worldwide investigation by Maudot et al. revealed moderate sensitivity.[3] They observed that the study's sensitivity was 52%, specificity was 85%, PPV was 77%, and NPV was 86%.[37] The author said that TVS is the non-invasive diagnostic technique most commonly used in the field of gynecology. Additionally, despite its modest diagnostic accuracy, it is the first and recommended approach for diagnosing

adenomyosis because of its widespread acceptability and cost-effectiveness.
This study highlights the utility of transvaginal sonography (TVS) as a reliable tool for diagnosing adenomyosis. The high sensitivity (95.9%) and specificity (100%) of TVS confirm its efficacy in detecting histopathologically confirmed adenomyosis, demonstrating its critical role in non-invasive diagnostics. Factors such as older age, globular uterine configuration, sub-endometrial echogenic junctions, and the ability to identify the endo-myometrial junction significantly correlated with TVS-confirmed adenomyosis, suggesting these features as important sonographic markers. Interestingly, myometrial cysts and asymmetric uterine wall thickening, though traditionally linked to adenomyosis, did not show statistical significance in this study, suggesting potential variability in their diagnostic utility. These findings underscore the importance of a comprehensive sonographic evaluation incorporating multiple parameters for accurate diagnosis. The excellent diagnostic accuracy of TVS, coupled with its non-invasive nature, positions it as a preferred initial investigation for suspected adenomyosis. However, the reliance on histopathology as the gold standard emphasizes the need for histological confirmation in ambiguous cases. Further studies are warranted to explore variations in sonographic features and their predictive value across diverse populations, enhancing the precision of adenomyosis diagnosis. The diagnostic performance of TVS was shown to be high and comparable to that of MRI in a comprehensive review and meta-analysis conducted by Liu et al.[43]
Important information on the frequency of adenomyosis detection by sonography was obtained from our study. In the population under study, the total frequency of adenomyosis was determined to be 76.7%. Although reported frequency varies greatly among populations, this data is somewhat consistent with other research demonstrating that adenomyosis is a common disorder among women of reproductive age.[44] Transvaginal US had a sensitivity of 83.3%, specificity of 86.8%, positive predictive value of 66.7%, negative predictive value of 94.3%, and diagnostic accuracy of 85.4% in the diagnosis of adenomyosis in another research conducted by Hussein NAM et al. [12]. Fedele et al.'s study, which using transvaginal ultrasound, demonstrated 87% sensitivity and 99% specificity in the identification of 23 cases of localized adenomyosis among 405 patients having uterine mass surgery. Furthermore, in 43 patients having menorrhagia surgery, the same team of investigators assessed the diagnostic accuracy of endovaginal US for diffuse adenomyosis in cases where there was no indication of leiomyoma or endometrial disease during abdominal US and Vabra curettage, respectively.[45]
A prior research[41] determined that sub-endometrial linear striations were the most distinctive characteristic of TVS for adenomyosis. Furthermore, the enlarged globular uterus was highly accurate in diagnosing adenomyosis. Indistinct endometrial myometrial and heterogeneous-appearing uterine myometrium may accompany localized or widespread thickening of the myometrium. One description of this look is Venetian blind shadowing.[46]
In a different investigation, the most common characteristics were found to be heterogeneous myometrium, myometrial cysts, and an inadequately defined junctional zone between the endometrium and myometrium, coupled with a globular uterine enlargement that was related to these findings.[3]
The very limited sample size that comes with being single-center research is one of its main limitations. More comprehensive research involving many centers and a wider range of patients is required to produce more reliable evaluations of the diagnostic precision of sonography in identifying adenomyosis. Second, not all radiologists or institutions may apply the same diagnostic standards while doing sonography for adenomyosis. Diagnostic accuracy may be impacted by

differences in how some sonographic findings—like uterine wall thickness and myometrial cysts are interpreted.

Conclusion

Our findings demonstrated that transvaginal ultrasonography (TVUS), using histopathology as the gold standard, may identify adenomyosis with good sensitivity, specificity, and diagnostic accuracy. Thus, it can be concluded that transvaginal ultrasonography can detect adenomyosis rather well. Furthermore, the presence of sub-endometrial linear striation is the most consistent sonographic finding. Other characteristics that support the diagnosis of adenomyosis include heterogenous myometrium, myometrial cysts, and a globular uterine structure. So, when adenomyosis is suspected in a patient, transvaginal US should be used as the initial imaging modality.

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