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Original Research Article

Diagnostic Accuracy of Ultrasonography in Diagnosing Uterine Adenomyosis Using Magnetic Resonance Imaging as the Gold Standard

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Abstract: *Uterine adenomyosis is a common benign gynecological disorder that may present with dysmenorrhea, abnormal uterine bleeding, and chronic pelvic pain. Magnetic resonance imaging is considered a reliable reference standard, while ultrasonography remains a widely available first-line diagnostic modality.* ***Objective:*** *To determine the diagnostic accuracy of ultrasonography in diagnosing of uterine adenomyosis keeping magnetic resonance imaging as gold standard.* ***Methods:*** *This study was conducted on 215 females aged 18 to 45 years with suspected adenomyosis. Patients who had recent uterine surgery, uterine fibroids, pelvic inflammatory disease, and tubal pathology were excluded from the study. All patients underwent transvaginal ultrasound, which was followed by pelvic MRI. Diagnostic accuracy including sensitivity, specificity, positive predictive value, and negative predictive value, were calculated using a 2×2 contingency table, keeping the MRI as gold standard. SPSS 25 was used for analysis. Stratification was performed using chi square test, keeping significance level at 5%.* ***Results:*** *The mean age of 215 patients in this study was 30.17±7.84 years and their mean body mass index was 26.86±2.65 kg/m2. MRI showed positive adenomyosis in 136 patients (63.3%), which ultrasound was positive for adenomyosis in 115 (53.5%) patients. Ultrasonography exhibited sensitivity of 69.12%, specificity 73.42%, positive predictive value of 81.74%, negative predictive value 58.00%, and diagnostic accuracy 70.70%.* ***Conclusion:*** *The diagnostic accuracy of ultrasonography in diagnosing uterine adenomyosis keeping magnetic resonance imaging as gold standard was 70.70%, with sensitivity 69.12% and specificity 73.42%.*

Keywords: Adenomyosis; Diagnostic accuracy; Magnetic resonance imaging; Transvaginal ultrasound; Uterine diseases.

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Introduction

Adenomyosis is a non-cancerous condition of the uterus. It is typically diagnosed by examining tissue samples taken during a hysterectomy. Specifically, doctors look for abnormal growth of endometrial glands and tissue below the endomyometrial junction, at least 2.5 mm deep, with an enlarged and overgrown surrounding muscle layer of the uterus (1). With the advancement of imaging technology, it became possible to diagnose adenomyosis using a non-invasive approach. This has enabled the condition to be detected sooner in clinical settings. Magnetic resonance imaging and ultrasonography are both effective in detecting adenomyosis, with comparable levels of sensitivity and specificity. These imaging techniques are increasingly utilized to identify adenomyotic lesions and determine appropriate treatment strategies (2). Diagnosing adenomyosis is challenging due to the overlap of signs and symptoms with other prevalent gynecologic disorders. Typical symptoms encompass excessive menstrual bleeding or dysmenorrhea (3, 4).

The clinical diagnosis is difficult due to the nonspecific nature of the symptoms. Adenomyosis is often found together with other gynecological disorders such leiomyoma, endometriosis, and endometrial polyps, which can cause comparable symptoms (5). Accurate diagnosis is crucial for selecting the appropriate medicinal or surgical therapeutic choices for these disorders. The diagnosis is traditionally established through the examination of histological findings following a hysterectomy. Endometrial tissue is located within the myometrium when seen under a microscope. Nevertheless, the diagnosis is not simple (6).

Ultrasonography is a highly appealing choice for diagnosis due to its minimum invasiveness, cost-effectiveness, and easy accessibility. Various grayscale characteristics have been identified as indicative of adenomyosis, such as a rounded uterus, uneven myometrium, streaky appearance of the myometrium resembling venetian blinds or a rain shower, cysts within the myometrium, unclear boundary between the endometrium and myometrium, and echogenic linear patterns extending from the endometrium into the inner myometrium (7). Women, especially those who want to have children in the future, may find it unacceptable to undergo deep biopsies for a thorough inspection of the myometrium. Imaging techniques like as 2D ultrasound and MRI have made it possible to diagnose adenomyosis without the need for invasive procedures. However, MRI was more frequently able to correctly identify the condition (7). A study observed the frequency of adenomyosis was 65% (8), while recorded sensitivity and specificity of ultrasonography was (36.8%) and specificity (91.8%) (9).

Ultrasonography is commonly used for initial evaluation but may vary in accuracy compared to MRI which is considered more sensitive and specific. Due to paucity of literature on this subject locally, the goal of this study is to determine the diagnostic accuracy of ultrasonography in diagnosing of uterine adenomyosis keeping magnetic resonance imaging as gold standard at our hospital. By understanding the diagnostic yields of these imaging modalities, the study seeks to enhance diagnostic precision and optimize clinical management strategies for patients with suspected adenomyosis.

Methodology

The present was conducted in the Radiology Department, Lady Reading Hospital, Peshawar. This study was a cross sectional validation study from 11-Septemeber-2024 to 11-March-2025. Ethical approval was taken before starting the study. Two hundred fifteen patients were selected using WHO sample size calculator by keeping the following parameters in consideration, frequency of adenomyosis (65%) (8), sensitivity (36.8%) and specificity (91.8%) (9) of ultrasonography in diagnosing of uterine adenomyosis. absolute precision 8%, and confidence level 95%. Non-probability sampling was used for the selection of patients.

Patients were females aged 18 to 45 years, suspected women with menstrual irregularities, pelvic pain (VAS>3), and pelvic pressure. Those with recent uterine surgery, uterine fibroids, pelvic inflammatory disease and tubal pathology were excluded.

Informed written consent was taken from the patients. Baselines demographics such as age, BMI, socio economic status, residence area, education status, and employments status were recorded. History of diabetes, and hypertension were recorded as well. Suspected women with adenomyosis underwent ultrasound assessment and the findings were recorded. On ultrasonography adenomyosis was defined as presence of all of the following features, such as heterogeneous myometrial texture characterized by areas of hypoechoic (dark), hyperechoic (bright) regions within the myometrium, small anechoic (fluid-filled) spaces within the myometrium, and myometrium thickness >12 mm. Then patients underwent MRI assessment and the findings were recorded. On MRI adenomyosis was defined as presence of all of the following features, such as junctional zone demonstrating a heterogeneous or striated appearance, myometrial T2-weighted hyperintensity, and sub-endometrial linear striations. Both ultrasound and MRI findings were compared for diagnostic accuracy. Entire assessment was carried out under the guidance of a radiologist with minimum 5 years of post-fellowship experience.

IBM SPSS 25 was used to analyze the data. Mean + SD were presented for numerical data such as age, and BMI. Frequencies and percentages were presented for categorical data such as ultrasound findings, MRI findings, residence area, socio economic status, education status, employments status, diabetes, and hypertension. Diagnostic accuracy of ultrasound, along with sensitivity, specificity, positive predictive value and negative predictive value were calculated by using the 2x2 contingency table keeping MRI findings as gold standard. Diagnostic accuracy was stratified by age, BMI, residence area, socio economic status, education status, employments status, diabetes, and hypertension to observe the effect modifiers. Post stratification Chi square/Fisher exact test was performed at 5% level of significance.

Results

The study included 215 female patients. The mean age of the patients was 30.17±7.84 years. The mean body mass index was 26.86±2.65 kg/m2. Regarding socio-economic distribution the majority of the patients were from the lower class, 92 (42.8%). In terms of education, 125 (58.1%) were illiterate. Patients residing in urban areas were 111 (51.6%). Employment status showed that 133 patients (61.9%) were unemployed (Table 1). Table 2 presents the medical comorbidities of the patients.

On transvaginal ultrasound uterine adenomyosis was positive in 115 patients (53.5%). On magnetic resonance imaging adenomyosis was positive in 136 cases (63.3%) (Table 3).

The sensitivity of transvaginal ultrasound for diagnosing uterine adenomyosis was 69.12%. The specificity was 73.42%. The positive predictive value was 81.74% and the negative predictive value was 58.00%. The diagnostic accuracy of ultrasound was found to be 70.70% (Table 4). Table 5 presents the stratification of diagnostic accuracy with various parameters.

Table 1: Demographics

Demographics		**n**	**%**
Socio economic status	Lower Class	92	42.8%
	Middle Class	81	37.7%
	Upper Class	42	19.5%
Education status	Literate	90	41.9%
	Illiterate	125	58.1%
Residence	Urban	111	51.6%
	Rural	104	48.4%
Employment status	Employed	82	38.1%
	Unemployed	133	61.9%

Table 2: Medical comorbidities

Comorbidities		**n**	**%**
Diabetes	Yes	38	17.7%
	No	177	82.3%
Hypertension	Yes	54	25.1%
	No	161	74.9%

Table 3: Adenomyosis on ultrasound and MRI

Adenomyosis on ultrasound and MRI		**n**	**%**
Uterine Adenomyosis on Ultrasound	Positive	115	53.5%
	Negative	100	46.5%
Uterine Adenomyosis on MRI	Positive	136	63.3%
	Negative	79	36.7%

Table 4: Diagnostic accuracy of ultrasound in diagnosing Adenomyosis

		Uterine Adenomyosis on MRI		**Total**
		Positive	**Negative**	
Uterine Adenomyosis on Ultrasound	Positive	94	21	115
		69.1%	26.6%	53.5%
	Negative	42	58	100
		30.9%	73.4%	46.5%
Total		136	79	215
		100.0%	100.0%	100.0%
Sensitivity = 69.12%; Specificity = 73.42%; Positive Predictive Value = 81.74%; Negative Predictive Value = 58%; Diagnostic Accuracy = 70.70%				

Table 5: Stratification of Diagnostic accuracy of ultrasound in diagnosing Adenomyosis with various parameters

Parameters	Sensitivity %	Specificity	PPV	NPV	Diagnostic accuracy	P value
Age (Years)						
18 to 30	71.43	82.61	84.91	67.86	76.15	0.001
> 30	67.12	60.61	79.03	45.45	65.09	0.001
BMI (kg/m^2)						
18.5 to 24.9	65.00	72.73	81.25	53.33	67.74	0.004
> 24.9	70.83	73.68	81.93	60.00	71.90	0.001
SES						
Lower Class	71.15	65.00	72.55	63.41	68.48	0.001
Middle Class	67.27	84.62	90.24	55.00	72.84	0.001
Upper Class	68.97	76.92	86.96	52.63	71.43	0.006
Education status						
Literate	66.07	76.47	82.22	57.78	70.00	0.001
Illiterate	71.25	71.11	81.43	58.18	71.20	0.001
Residence						
Urban	76.12	75.00	82.26	67.35	75.68	0.001
Rural	62.32	71.43	81.13	49.02	65.38	0.001
Employment status						
Employed	70.21	80.00	82.50	66.67	74.39	0.001
Unemployed	68.54	68.18	81.33	51.72	68.42	0.001
Diabetes						
Yes	76.00	69.23	82.61	60.00	73.68	0.007
No	67.57	74.24	81.52	57.65	70.06	0.001
Hypertension						
Yes	71.05	50.00	77.14	42.11	64.81	0.139
No	68.37	79.37	83.75	61.73	72.67	0.001

Discussion

The diagnostic accuracy of non-invasive imaging for adenomyosis has been thoroughly evaluated in the literature with most studies using histopathology as the reference standard. Tariq et al. reported that magnetic resonance imaging demonstrated superior diagnostic accuracy compared to transvaginal ultrasound. In their study of 162 patients MRI had sensitivity of 86.7% and specificity of 36.9% while ultrasound showed sensitivity of 65.7% and specificity of 50.9%. They concluded that MRI should be performed before deciding on hysterectomy.(10)

A review conducted by Gallo et al. gathered data from 12 studies and found that transvaginal ultrasound had sensitivity 78.5% and specificity 70.7%, while MRI showed sensitivity 64.8% and specificity 87.5%. The review highlighted that specific ultrasound markers such as junctional zone thickness of 8 mm or greater fan-shaped striations and the question mark sign were associated with high specificity.(11)

Shaikh et al. in their study using MRI as the gold standard among 208 patients reported that transvaginal ultrasound had sensitivity of 74.36% and specificity of 96.15%, with a positive predictive value of 98.31%. Their study suggested that ultrasound could serve as a reliable first-line tool reserving MRI for inconclusive cases.(12)

Anjum et al. in their study compared both modalities with histopathology in 101 patients and found that ultrasound had sensitivity of 88.0% and specificity of 92.1% while MRI exhibited sensitivity of 84.0% and specificity of 96.0%.(13) Maudot et al. conducted a retrospective study on diagnostic accuracy on 510 women, taking histopathology as reference, and reported lower performance for sonography with sensitivity of 52% and specificity of 87%, reflecting current clinical practice with varying operator expertise.(14)

Rohini et al. analyzed the Morphological Uterus Sonographic Assessment criteria in 105 patients and found that sunray appearance and asymmetrical thickening of the myometrium had the highest sensitivity at 80.85% each, while subendometrial lines, translesional vascularity and hyperechoic islands demonstrated the highest specificity more than 90%.(15)

The present study enrolled 215 patients with mean age 30.17±7.84 years and mean BMI 26.86±2.65 kg/m2. Adenomyosis on MRI was positive in 63.3% patients. Transvaginal ultrasound showed sensitivity of 69.12%, specificity of 73.42%, positive predictive value of 81.74%, negative predictive value of 58.00% and diagnostic accuracy of 70.70% with MRI as the reference standard.

Compared to the findings of Shaikh et al. who reported sensitivity of 74.36% and specificity of 96.15% the present study showed lower sensitivity and lower specificity.(12) The findings of the present study are more similar to those reported by Maudot and et al. who found sensitivity of 52% and specificity of 87% in routine clinical practice, which suggesting that the results of the present study accurately reflect real-world diagnostic performance rather than expert-level interpretation.

Conclusion

The present study concludes that the diagnostic accuracy of ultrasonography in diagnosing uterine adenomyosis keeping magnetic resonance imaging as gold standard was 70.70%. The modality had sensitivity of 69.12% and specificity of 73.42%. Transvaginal ultrasonography may be used in clinical settings as a first-line imaging modality for suspected adenomyosis given its acceptable diagnostic accuracy, wide availability and cost-effectiveness.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (276/LRH/MTI)

Consent for publication

Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

SI (Trainee Medical Offier)
Manuscript drafting, Data Collection, Study Design,
NU (Assistant Professor)
Critical input and final approval of the manuscript.

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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