Diagnostic Accuracy of Ultrasound and MRI for Diagnosis of Adenomyosis Taking Histopathology as Gold Standard

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ABSTRACT

Objective: To determine the diagnostic accuracy of Magnetic Resonance Imaging (MRI) and ultrasonography to detect adenomyosis, keeping histopathology as the gold standard.

Study Design: Cross-sectional study.

Place and Duration of Study: Radiology and Gynecology departments of the Combined Military Hospital, Quetta Pakistan, from Aug 2019 to Aug 2021.

Methodology: One hundred sixty-two patients were enrolled in this study after taking written and informed consent. After taking history, all patients were assessed by Magnetic resonance imaging and transvaginal ultrasonography. The magnetic resonance imaging and transvaginal ultrasound findings were noted on a predesigned proforma. All the patients underwent a hysterectomy, and a Biopsy specimen was sent for histological confirmation of adenomyosis. The accuracy of diagnosis was assessed in both initial modalities.

Results: A total of 162 patients were enrolled in the study. The mean age of the females and junctional zone diameter (JZmax) in mm on MRI was 38.56 years and 12.54.9 mm. In terms of parity, 32 (19.8%) females were nulliparous, 68 (42%) females had low multi-parity, and 62 (38.2%) females had high multi-parity. On magnetic resonance imaging, adenomyosis was present in 112 (69.1%) females. On transvaginal ultrasound, it was present in 97 (59.9%) females, and on histopathology, it was present in 105 (64.8%) females, out of which 36 (34%) had diffuse adenomyosis and 32 (30.8%) had focal adenomyosis. The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of Magnetic resonance imaging was 86.7%, 36.9%, 81.3%, 71.8% and 78.4% respectively and of transvaginal ultrasound it was 65.7%, 50.9%, 71.1%, 44.6% and 60.5% respectively.

Conclusion: Magnetic resonance imaging has superior diagnostic accuracy for adenomyosis than transvaginal ultrasound.

Keywords: Adenomyosis, Hysterectomy, Magnetic resonance imaging, Transvaginal ultrasound.

How to Cite This Article: *Tariq M, Anwar J, Amin N, Gul B, Niaz A, Nawaz HK. Diagnostic Accuracy of Ultrasound and MRI for Diagnosis of Adenomyosis taking Histopathology as Gold Standard. Pak Armed Forces Med J 2022; 72(Suppl-2): S346-349. DOI: https://10.51253/pafmj.v72iSUPPL-2.8064*

INTRODUCTION

Clinical criteria alone cannot be used to accurately diagnose adenomyosis.[1] Nonetheless, hysterectomy is frequently performed based solely on suspected symptoms.[1] To avoid needless hysterectomy and, if possible, to investigate non-surgical options, better preoperative diagnostic approaches are required.[2] Furthermore, it is important to diagnose adenomyosis prior to hysteroscopic surgery in patients with abnormal uterine bleeding as it decreases the impact of endometrial ablation. Before myomectomy, focal adenomyosis must be detached from myomas.[3] Much research has been carried out to assess the diagnostic accuracy of transvaginal ultrasonography (TVS) for detecting adenomyosis.[4] However, there is a lack of a comprehensive picture of TVS diagnostic precision. Patients are frequently chosen based on symptoms clinically or masses in uterine areas where adenomyosis is common, or studies have only differentiated between myomas and adenomyomas, leaving out diffuse adenomyosis.[5] Magnetic resonance imaging (MRI) has shown promising results in diagnosing adenomyosis.[6]

In a few studies, the diagnostic potential of MRI and TVS has been compared, with conflicting results.[7] Dueholm *et al*, in their study, revealed that for the diagnosis of adenomyosis, the sensitivity and specificity of MRI were 70% and 86%, respectively, whereas, for Transvaginal ultrasound, it was 68% and 65%, respectively.[7] Jabbar *et al*, revealed that for diagnosing adenomyosis, the sensitivity and specificity of MRI versus ultrasound were 58% vs 92% and 100% for both, respectively.[8] A meta-analysis revealed that the pooled sensitivity and specificity of MRI in terms of maximum thickness of JZ area were 71.6% and 85.5%, respectively.[9] Sam *et al,* revealed that ultrasound was 36.8%

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Received: 27 Jan 2022; revision received: 12 Apr 2022; accepted: 14 Apr 2022

sensitive and 91.8% specific for the diagnosis of adenomyosis.[10]

Much research has been carried out internationally regarding the diagnostic modalities for adenomyosis. However, local data is scarce. The rationale of the present study is to determine the diagnostic accuracy of Magnetic resonance imaging (MRI) and ultrasonography for the detection of adenomyosis, keeping histopathology as the gold standard. This will help provide information about the benefits of a non-invasive technique that is less time consuming and can provide early diagnosis and help in early intervention.

METHODOLOGY

It was a cross-sectional study. The study was conducted in the Radiology and Gynecology departments of the Combined Military Hospital, Quetta Pakistan, from August 2019 to August 2021. Ethical Review Committee approval was obtained (certificate number CMH Qta-IRB/009). A total of 162 females were enrolled in this study.

Inclusion Criteria: Female patients with ages ranging from 20 to 50 years who had the suspicion of adenomyosis for symptoms of menorrhagia and dysmenorrhea for which they were scheduled for hysterectomy were included in this study.

Exclusion Criteria: Patients with a history of cancer, transcervical resection of the endometrium or an acute or subacute indication for hysterectomy were excluded from this study. With a 95 percent confidence interval and a 5% margin of error, the sample size was determined using the estimated percentage of adenomyosis as 8.8%,[11] in premenopausal females who had a plan to undergo a hysterectomy. The technique of sampling utilized was non-probability consecutive sampling.

Written informed consent was taken from all the patients. The researchers themselves carried out demographic detail, clinical history and physical examination of all patients, and all findings were noted down in a predesigned proforma. All the patients underwent Magnetic resonance imaging (MRI) and transvaginal ultrasonography scan (TVS), followed by a hysterectomy. Then the biopsy specimen was then sent to a histopathologist for histopathological confirmation of the diagnosis. Two consultant radiologists were taken on board, one of which did the MRI of the patients, and the other consultant radiologist did TVS. The results of magnetic resonance imaging, television screening, and pathologic examinations were sequentially assessed without knowing the findings of the other investigators.

1.5-Tesla scanners were used for MRI. In the axial, coronal and sagittal planes relative to the direction of the uterine cavity, 4-mm slices with a spacing of 1-mm in all three planes were acquired using rapid (turbo) spin-echo sequences on T2-weighted images. The data was collected using surface coils (phase array pelvic coils), and the test took 30 to 45 minutes to complete. The thickness of JZ contours was termed as uniform or non-uniform. The thickness of the anterior and posterior walls was measured in the sagittal slices at the thinnest (JZmin) and thickest (JZmax) areas. The difference between JZmax and JZmin (JZdif) was computed for the front or posterior boundary. The difference between JZmax and JZmin (JZdif) was calculated for the front or posterior boundary. The greatest parameter, whether anterior or posterior, was chosen in all calculations. At JZmax of 15 mm, diffuse adenomyosis was suspected. When the thickness of 12-15 mm was present, one of the criteria was assessed for considering adenomyosis which included a non-uniform, thickened Junctional zone (JZ) or focal not well-demarcated high or low-intensity patches in the myometrium were present. Each criterion's presence or absence was noted in lesions suspected of adenomyosis.

Sonography was performed in two perpendicular planes using an Acuson 3.0 Sequoia 512 scanner with 5.0-, 6.0-, 7.0-, and 8.0-MHz transvaginal transducers and 8.0- 5.0-MHz abdominal transducers. We looked for focal areas with ill-defined borders or a strange echotexture. The following adenomyosis criteria were assessed when these areas were present: heterogeneity increased or decreased areas of echogenicity and myometrial cysts. If the criteria were met, adenomyosis was categorized as the present. A brief digital movie was created, as well as photographs with measurements.

On histopathological evaluation, when endometrial glands or stroma were spread diffusely in the myometrium, it was named diffuse adenomyosis. When circumscribed nodular masses were identified, it was labelled focal adenomyosis. All findings were noted on a predesigned proforma and subjected to statistical analysis.

A statistical package for the social sciences version 23.0 was used to analyse the data. Quantitative variables such as age and diameter of the junctional zone were presented as mean and standard deviation.

Qualitative data such as parity status (single versus multiparous), findings of adenomyosis of MRI, TVS and histopathology reports and type of adenomyosis (focal or diffuse) were presented as frequency and percentage. Data was stratified for age and parity. 2X2 tables were made to determine the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy of MRI and TVS, keeping histopathology as the gold standard.

RESULTS

The mean age of the females and junctional zone diameter (JZmax) in mm on MRI was 38.56 years and 12.54.9 (Table-I).

Table-I: Descriptive statistics.

Variable	Frequency (Percentage)
Age (In Years)	38.5 ± 6
Junctional zone diameter (In mm)	12.5 ± 4.9
Age Groups	
Young age (20-30 years)	22 (13.6%)
Early Middle Age (31 to 40 Years)	72 (44.4%)
Late Middle Age (41 to 50 Years)	68 (42%)
Parity	
Nulliparous (No Pregnancy)	32 (19.8%)
Low multiparous (1-3 Pregnancies)	68 (42%)
High multipara (4 or More Pregnancies)	62 (38.2%)
Findings of Adenomyosis on Magnetic Resonance Imaging	
Present	112 (69.1%)
Absent	50 (30.9%)
Findings of Adenomyosis on Transvaginal Ultrasound	
Present	97 (59.9%)
Absent	65 (40.1%)
Findings of Adenomyosis on Histopathology	
Present	105 (64.8%)
Absent	57 (35.2%)
Type of Adenomyosis on Histopathology	
Diffuse	55 (34%)
Focal	50 (30.8%)

In terms of age group, 22 (13.6%) females were young, 72 (44.4%) were of early middle age, and 68 (42%) were of late middle age (Table-II).

Table-II: Diagnostic accuracy table for magnetic resonance imaging keeping histopathology as gold standard.

Adenomyosis Findings on Magnetic Resonance Imaging	Findings on Histopathology	
	Present	Absent
Present	True Positive 69 (42.6%)	False Positive 28 (17.3%)
Absent	False Negative 36 (22.2%)	True Negative 29 (17.9%)

In terms of parity, 32 (19.8%) females were nulliparous, 68 (42%) females had low multiparity, and 62 (38.2%) females had high multiparity. On magnetic resonance imaging, adenomyosis was present in 112 (69.1%) females, on transvaginal ultrasound, it was present in 97 (59.9%) females, and on histopathology, it was present in 105 (64.8%) females, out of which 36 (34%) had diffuse adenomyosis, and 32 (30.8%) had focal adenomyosis. The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of Magnetic resonance imaging were 86.7%, 36.9%, 81.3%, 71.8% and 78.4%, respectively (Table-II), and of transvaginal ultrasound, it was 65.7%, 50.9%, 71.1%, 44.6% and 60.5% respectively (Table-III).

Table-III: Diagnostic accuracy table for transvaginal ultrasound keeping histopathology as gold standard.

Adenomyosis Findings on Transvaginal Ultrasound	Findings on Histopathology	
	Present	Absent
Present	True Positive 91 (56.2%)	False Positive 21 (13%)
Absent	False Negative 14 (8.6%)	True Negative 36 (22.2%)

DISCUSSION

Current study results revealed that the sensitivity and specificity of Magnetic resonance imaging were 86.7% and 36.9%, respectively, diagnostic accuracy was 78.4%, transvaginal ultrasound, it was 65.7% and 50.9%, respectively, and accuracy was 60.5%, keeping histopathology as the gold standard. Magnetic resonance imaging was superior in terms of accuracy in detecting adenomyosis compared to transvaginal ultrasound. Diffuse adenomyosis was found in 34% of histopathology, and focal adenomyosis was found in 30.8%. Adenomyosis was more common in females of early and late middle age, i.e., 28.4% each. However, this association was also found to be statistically insignificant. In terms of parity, it was found that adenomyosis was more frequently seen in females who had low parity, i.e., 26.5%, followed by those who had high parity, i.e., 25.9%. However, this association was also found to be statistically insignificant.

In this study, MRI outperformed TVS in diagnosing adenomyosis. The sensitivity of MRI measurements was much better than that of TVS measurements, and measurements yielded more distinct and objective results on MRI compared to TVS measurements. The specificity of MRI was slightly higher than that of TVS.

The diagnosis of adenomyosis is critical, especially for women experiencing unexplained pelvic pain and considering hysterectomy as their only option.[12-14]

Ultrasound, both transvaginal and transabdominal, is the initial imaging modality used to screen females with a history of menorrhagia, pelvic pain, and infertility.[15]

In a systematic review by Bazot *et al*,[13] the pooled sensitivity of transvaginal ultrasound for adenomyosis was 72%, and pooled specificity was 85%. In contrast, the pooled sensitivity and pooled specificity of MRI were 77% and 89%, respectively. The conclusion of this study is in concurrence with the results of our study in favour of MRI for diagnostic accuracy of adenomyosis. Novellas *et al*, found that MR imaging had an 85 percent diagnostic accuracy in adenomyosis.[16,17] Their results also prove the superiority of MRI in diagnosing adenomyosis, like our study. The discovery of a junctional zone thickness greater than 12 mm was the most significant.[18] Current study results also showed the superiority of MRI over TVS in terms of sensitivity and accuracy.

Our study similarly revealed that the mean thickness was 12.5mm on MRI in patients enrolled in the study in junctional zone thickness. However, the association of findings in thickness was not assessed further. Rasmussen *et al*, revealed that TVS had a sensitivity and specificity of 72% and 69% for adenomyosis, respectively.[14] Shwayder *et al*, revealed that TVS had a sensitivity and specificity of 65%.[19] Our study similarly revealed low sensitivity and specificity of TVS for adenomyosis, i.e., 65.7% and 50.9%. Trans-vaginal ultrasonography is the natural first choice of image modality when evaluating pelvic pain or menstrual issues. However, an accurate adenomyosis diagnosis requires sonographers skilled in adenom-yosis pattern recognition.[20]

LIMITATIONS OF STUDY

The causes of adenomyosis were not assessed. The accuracy of different characteristic criteria was not assessed independently using these modalities.

CONCLUSION

The current study concludes that magnetic resonance imaging has superior accuracy for diagnosing adenomyosis than transvaginal ultrasound and must be carried out while deciding on hysterectomy as it may help in guiding the diagnosis and hence the right treatment approach. Future studies must be conducted on a larger sample size and must also include the secondary causes of this condition to validate current study findings.

Conflict of Interest: None.

Author's Contribution

MT:, BG: Data collection, JA: Conception, design, intellectual, interpertation, NA: Substential contribution in acquisition of data, AN: Data monitoring, KHN: Fianl approval of the draft.

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