Original Article

Comparing Accuracies of Transvaginal Ultrasonography and Magnetic Resonance Imaging for Nonsurgical Diagnosis of Adenomyosis

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Abstract

Objective: To compare the diagnostic accuracies of TVS and MRI in diagnosis of adenomyosis.
Methodology: A cross sectional study was conducted in Radiology Department of Sir Ganga Ram Hospital Lahore from July 2017 to Jan 2018. 120 females of age 38 to 50years fulfilling inclusion criteria were registered in the study. Patients undergone TVS with endovaginal probe of TOSHIBA Aplio and labeled as positive or negative for findings. Patients then had MRI and confirmed as positive or negative. Data was analyzed by SPSS 20. Sensitivity, specificity, PPV, NPV and accuracy were estimated for TVS and MRI by generating 2x2 contingency table.
Results: The mean age of the patients was demonstrated to be 44.2 ± 5.12 years. Frequency of adenomyosis was revealed in 82 out of 120(68.3%) women who underwent TVS while 38 (31.7%) were negative. Conversely; at MRI 93 (77.5%) women had confirmation of adenomyosis and 27 (22.5%) were negative. Therefore, TVS sensitivity, specificity, PPV, NPV and accuracy was proven to be 82.8%, 81.5%, 93.9%, 57.9% and 82.5%, respectively for diagnosis of adenomyosis.
Conclusion: TVS and MRI have high diagnostic accuracies as a pre-operative diagnostic tools for adenomyosis. So we can recommend TVS in daily practice for screening and early diagnosis of adenomyosis and if findings are inconclusive or associated with other pelvic pathologies further MRI will result in best therapeutic outcome for patients. Results of this study will help in future for easy and unchallenging diagnosis of adenomyosis and will improve our clinical practice and local guidelines.

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Introduction

The definition of adenomyosis is ectopic endometrial glands located within the myometrium that induce a hypertrophic and hyperplastic reaction in the surrounding myometrial tissue.[1] Patient presents in the late reproductive period with pelvic bleeding and pain. The reported frequency of adenomyosis was 39.9% among females presenting with abnormal uterine bleeding.[2] Continuous improvements in the resolution of TVS have eased the diagnosis of adenomyosis, which was not seen previously. Now TVS can be used as a first-line investigation for the suspicion of adenomyosis. However, MRI is used as a second-line investigation if the ultrasound evaluation is inconclusive or it is associated with other pelvic pathologies. TVS and magnetic resonance imaging (MRI), have high accuracy levels in the preoperative adenomyosis diagnosis. A study, conducted in Egypt, showed that TVS had sensitivity and specificity of 83% and 86%, and NPV and PPV of 66%and 94% respectively (n=50). [8] The reported accuracy of MRI in the diagnosis of adenomyosis is high, with its sensitivity and specificity around 80-100%. [5,6]

The rationale of this study is to compare the diagnostic accuracies of TVS and MRI in the diagnosis of adenomyosis. Previously, more studies were done on

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the diagnosis of adenomyosis through histopathology[12], so limited research has been done on its local prevalence, natural history, clinical significance, and association with other diseases. Also, the previous studies were conducted on a small sample size of less than 100 and were conducted in developed countries. There is no such study in a local setting. Today, a smaller number of patients are going through hysterectomy because of the benign nature of the disease[19] and more women want to be treated conservatively to reduce their symptoms. This study is done to determine the accuracies of non-surgical diagnostic tools for adenomyosis i.e. TVS and MRI.

Methodology

This was a cross-sectional study held in the radiology department of Sir Ganga Ram Hospital, Lahore, from July 2017 to January 2018. All 120 females aged 38–50 years presenting with menorrhagia, dysmenorrhea, irregular bleeding, and pelvic pain, referred from the Gynecology Department, were registered in the study. After taking informed consent, the patient's demographic data including patient's age, body mass index (kg/m2), gravidity/parity, duration of symptoms, history of pelvic surgery and menopausal status were taken. Females with a diagnosis of intra or extra-uterine malignancy (on medical record), metastasized disease (on medical record) and a medical record of hysterectomy were excluded. Then patients underwent a TVS scan with the endo-vaginal probe of TOSHIBA Aplio having a 65MHz frequency. During each TVS examination, characteristic direct and indirect signs of adenomyosis were observed as described in the following table.

Sonographic signs of adenomyosis.

Direct signs	Indirect signs
Subendometrial microcysts (2-9mm)	Enlarged globular uterus
Poorly defined or thickened endomyometrial junction zone	Asymmetrical anterior and posterior myometrial walls
Non homogenous myometrium (Linear hyperechoic myometrial striations and Subendometrial small hyperechoic nodules)	On doppler sonography linear vascular pattern within heterogenous myometrium.

The features we described are reliable morphological markers for adenomyosis and have been described in various studies.[7, 12, 20,21] These features have high specificity however, the sensitivity of each finding is low as not all women with adenomyosis have these features.[4] Tiny myometrial cysts are the most pathognomic sign having high specificity (98%), but low sensitivity (50%–65%).[10,22,25–28] Diffusely heterogenous myometrium is a common feature with high sensitivity (80.8%–100%), but low specificity (30%–65%).[22, 26, 28] Based on these features patients were labeled positive or negative for adenomyosis. All TVS scans were done by the researcher herself. Then patients were undergone MRI by a single senior radiologist. The most important MRI criterion for adenomyosis is the presence of T2WI hyperintense tiny inner myometrial cysts having the highest specificity. Other features are maximal junctional zone thickness > 12mm and JZ thickness to total myometrium ratio >40-50%.[21,22,23] JZ measurement should be taken on midsagittal T2WI appearing as low signal intensity between high signal endometrium and intermediate signal myometrium. Based on these MRI features patients were labeled as positive or negative.

All the data were analyzed through SPSS (version 20.0). Age was presented as mean and standard deviation. Parity and BMI were presented as frequency. Adenomyosis (on TVS and MRI) was presented as percentage and frequency. 2x2 contingency table was generated to calculate specificity, sensitivity, NPV, PPV and accuracy of TVS as well as MRI in diagnosing adenomyosis. Stratification of data i.e. age, BMI and parity, was done to calculate the specificity, sensitivity, NPV, PPV and accuracy of TVS for each stratum.

Results

The statistical analysis for a total of 120 patients who had undergone transvaginal scans and MRI was enumerated in this study after taking informed consent. The age distribution of the patient was 38 - 50 years with the mean of the patient's age calculated as (44.2 ± 5.12) years of which the lowest age was 38 years and the topmost was 50 years. All the patients who underwent transvaginal ultrasonography were detected positive for adenomyosis in 82 (68.3%) patients and negative in 38 (31.7%) patients. Similarly, magnetic resonance imaging detected adenomyosis positively in 93 (77.5%) and the other 27 (22.5%) had a negative MRI diagnosis. Of the 82 cases that were positively diagnosed with adenomyosis by TVS, 77 of the patients' (true positive) diagnoses were confirmed by the MRI. The true negative cases were confirmed 22 on both diagnostic modalities, whereas 5 false positive cases on TVS were declared and 16 cases were affirmed as a false negative. This data accomplishes that TVS was found to be sensitive and specific in diagnosing adenomyosis by generating a 2x2 contingency table with a sensitivity of 82.8%, followed by the specificity of 89.5%, PPV of 98.0%, NPV of 65.4%, and accuracy of 91.2%. (Table I & II)

Data were also stratified for body mass index in terms of normal, overweight, and obese patients, and it was discovered that 72/120 (60.0%) of the patients had the highest specificity, sensitivity, NPV, PPV, and accuracy of TVS when compared to other groups (88.9%, 83.3%, 64%, 95.7%, and 84.7%, respectively). (Table III) On stratification, concerning parity, it was confirmed that 19 women had 0 parity whereas 67 patients presented with parity of 4 or less and the TVS is found to be a more characteristic modality in the making of adenomyosis diagnosis, in parity <4 as compared to >4 with (85.4% vs 82.8%) sensitivity, (89.5%vs 40.0%) specificity, (95.3% vs 88.5%) PPV, (70.8%vs 28.6%) NPV and (86.6% vs 76.5%) accuracy, respectively. Hence, a significant difference was initiated between both groups. (Table IV)

Discussion

Adenomyosis commonly affects multiparous women of late reproductive age. It is presented clinically with menorrhagia and pelvic pain and has a 10% association with adenocarcinoma of the endometrium.[9] So accurate diagnosis of adenomyosis in each patient must be done with transvaginal ultrasonography as a first-line investigation, and if it comes inconclusive or other associated pathologies are found, then MRI is recommended. However, the gold standard is biopsy.[10] An ideal diagnostic test should be inexpensive, minimally invasive and easily available. It should be well accepted by the patient with high accuracy, sensitivity, and specificity. So, TVS can be used as a screening as well as a preoperative diagnostic tool with high diagnostic accuracy comparable to MRI. In our study, the mean age of the patients was calculated as 44.2±5.12 years whereas in Hashad AM[11] research on adenomyosis, who did study on 77 patients having mean age of 46(range, 40–55) years[11] having symptoms of abnormal uterine bleeding in 48 (62.33%), dysmenorrhea in 14 (18.18%) and both in 15 (19.48%). In another study done by Dueholm M[12] the mean age (+SD) was 44.7 ± 6 5.2 years having a range of 28–58 years.[12] The mean age in women with adenomyosis was 49.4±12.4 demonstrated by Chunda RG.[13] A study by Naftalin J.[5] The prevalence of adenomyosis increases with age having a peak up to 32% in women of 40–49yr. So based on these studies we analyzed that there is a significant association between age with the presence of adenomyosis. The clinical presentation of patients with adenomyosis which was reported more commonly in

Table I: Descriptive statistics of Age, TVS and MRI diagnosis of Adenomyosis.

		N	%
TVS diagnosis	Positive	82	68.3
	Negative	38	31.7
	Total	120	100
MRI findings	Positive	93	77.5
	Negative	27	22.5
	Total	120	100
Age (years)	44.2+5.12	38.00 (min)	50.00 (max)

Table II: Contingency table for Transvaginal Sonography x MRI (Adenomyosis diagnosis)

Diagnosis of Adenomyosis on TVS	Diagnosis of Adenomyosis on MRI		Total
	Negative	Positive	
Negative	22	16	38
Positive	5	77	82
Total	27	93	120

Sn: 82.8%, Sp: 81.5%, PPV: 93.9%, NPV: 57.9%, Accuracy: 82.5%

Table IV: Stratification with respect to Parity groups.

Parity Groups	TVS Diagnosis	MRI diagnosis		Total	P-value
		Positive	Negative		
0	Positive	12	0	12	0.013
	Negative	4	3	7	
	Total	16	3	19	
≤4	Positive	41	2	43	0.003
	Negative	7	17	24	
	Total	48	19	67	
>4	Positive	24	3	27	0.245
	Negative	5	2	7	
	Total	29	5	34	

Table III: Stratification with respect to Body Mass Index (BMI) groups.

BMI Groups	TVS Diagnosis	MRI diagnosis		Total	P-value
		Positive	Negative		
<25kg/m^2	Positive	3	1	4	0.540
	Negative	1	1	2	
	Total	4	2	6	
25-30	Positive	29	2	31	0.003
	Negative	6	5	11	
	Total	35	7	42	
≥30kg/m^2	Positive	45	2	47	0.000
	Negative	9	16	25	
	Total	54	18	72	

women was heavy menstrual bleeding 10 (62.5%), uterine size (12 weeks) 10 (62.5%), uterine tenderness (31.2%), dysmenorrhea 8 (50%). Pelvic bleeding was an indication for hysterectomy in 56.2% of patients with adenomyosis.[13] Typical symptoms of adenomyosis are dysmennorhea and menorrhagia, but many remain asymptomatic.[14] Similarly Ya-Min et al. and Elkattan et al. study results were menorrhagia in 51 out of 95 (53.7%), 90 out of 123 (73%) followed by dysmenorrhea in 17 out of 95 (17.9%), 10 out of 123 (8%) and multiple other symptoms in 17/95 (17.9%), 18/123 (14.6%) respectively.[11]

Reinhold et al.[9] described a specificity as high as 86% for transvaginal ultrasound in their study in 1995 and similar analytical efficiencies with transvaginal ultrasound and MRI.[10] Ascher et al. [17] suggested MRI as the modality of choice for the diagnosis of adenomyosis, especially in women with myoma. Bazot et al.[21] found the sensitivity and specificity of MRI for the diagnosis of adenomyosis to be 77.5% and 92.5%, respectively.[2] Their results suggest that transvaginal ultrasound and MRI have similar accuracy for the diagnosis of adenomyosis. MRI is expensive and is not readily available.[2,8,10,13] Nevertheless, in women with associated disorders, such as uterine fibroids, the diagnostic accuracy of transvaginal ultrasound is lower than is that of MRI.[2] The mean BMI was observed to be 31.2+4.78 which showed that most of the patients included in the study were obese and the duration of abnormal uterine bleeding was recorded less than two years among majority of the females. In the current study, the disease prevalence was 68.3% patients which is similar to the Egyptian study Hashad et al[11] reported the disease prevalence was in 48 out of 77 patients i.e. 62.3%. Exacoustos et al. showed the histological prevalence of adenomyosis of 44.4% (32 out of 72 patients) and [14] Bazot et al.[21] showed the histological prevalence of adenomyosis of 33% (40/120), this major difference is due to many factors like skills of researcher, criteria for diagnosis and sample characteristics. TVS can be used as a screening modality and first-line investigation for diagnosing adenomyosis with high diagnostic accuracy as provided recently in a study by Van den Bosch et al.[24] There are various direct features i.e. tiny sub endometrial cysts (2 to 9mm) are highly specific up to 98%, but sensitivity is low 50-65%. Other features include irregular or poorly defined endometrial myometrial junction and linear hyperechoic striation or nodules within the myometrium. Diffusely heterogenous myometrium is a very common feature having high sensitivity (80.8-100%) but low specificity (30-65%). The JZ is often visible as a hypoechogenic zone under the endometrium, histologically composed of longitudinal and circular smooth muscle fibers. Upon TVS, thickened or irregular JZ is characteristic of adenomyosis. Ahmadi[15] and Haghighi's[18] study results showed an 80% accurate diagnosis of adenomyosis by 3D transvaginal USG with a 95% positive predictive value based on a finding of an irregular widened JZ on the coronal plane.[15] Exacoustos et al did a study on 72 premenopausal patients with 2D and 3D transvaginal USG and found a 44% histological prevalence of adenomyosis.[14] They also assessed the characteristics of the junctional zone and resulted in the most definitive diagnosis of adenomyosis that can be made on TVS by measuring the junctional zone and its other features. Their study also showed that 2D TVS most characteristic feature is myometrial cysts having an accuracy of 78% and a specificity of 98%, while heterogeneous myometrium was the most common finding, making it the most sensitive finding having a sensitivity of 88% and accuracy of 75%. Upon 3D TVS, adenomyosis specific feature is a JZ width of more than or equal to 4 mm with the more sensitive feature of JZ infiltration and distortion having a high sensitivity of 88% and the accuracy of 85% and 82%, respectively. The overall accuracy of diagnosing adenomyosis for 2D was 83%, sensitivity 75%, specificity 90% and PPV 86% and for 3D transvaginal USG was 89%, 91%, 88% and 85% respectively. In our study adenomyosis was found positive in 82 cases and negative in 38 which were confirmed on MRI which was is most efficient in diagnosis and confirmed adenomyosis in 93 (77.5%) out of 120 cases and negative in 27 (22.5%). The specificity, sensitivity, NPV, PPV and accuracy of TVS are established as 81.5%, 82.8%, 57.9%, 93.9%, and 82.5% in the diagnosis of adenomyosis. Jagannathan et al[16] described in their recent study that 12 positive cases of adenomyosis were found among them sensitivity of TVs is 58% and MRI is 92%.[16] In a study of 21 premenopausal patients by Mark AS et al. (18), adenomyosis was diagnosed on MRI in 8 patients, and fibroid was correctly diagnosed in 10/12. According to Reinhold C etal9's study, 25 of 29 patients tested positive for adenomyosis in TVS, so its sensitivity, specificity, PPV, and NPV were 86%, 86%, 71%, and 94%, respectively.[18] Struble et al.[25] did a review study on adenomyosis which stated that 3D TVUS is more accurate than 2D TVUS for making an early diagnosis of adenomyosis. Graziano et al.[26] stated, that even though MRI was previously considered more diagnostic than

TVS, recent studies have now proved that both are comparable in diagnosis.

Conclusion

Our study results proved that TVS and MRI diagnostic accuracies are comparable. TVS can be used as a first-line investigation and screening modality in the detection of adenomyosis because it is inexpensive, widely available, and well tolerated, so it can further facilitate large-scale studies of adenomyosis in different populations of women and improve our local guidelines. TVS and MRI could be recommended for a definite preoperative diagnosis of adenomyosis. Further surveys should be done about the natural history of adenomyosis, its possible associations with different symptoms including subfertility, and plan prevention and treatment strategies.

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