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Original Research Article

Correlation between transvaginal sonographic evaluation of adenomyosis and histopathological outcomes

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ABSTRACT

Background: Transvaginal sonography is a popular method to diagnose adenomyosis, leiomyoma and other pathology of uterus which ultimately lead to hysterectomy operative procedure. This prospective study was conducted in the Department of Radiology and Imaging, Bangabandhu Sheikh Mujib Medical University (BSMMU) to evaluate the accuracy of various transvaginal ultrasonographic findings (TVS) in the diagnosis of adenomyosis with correlation of histopathological results.
Methods: One hundred and forty patients scheduled for hysterectomy also selected for preoperative transvaginal sonography. All sonographic findings were compared with the histopathological results.
Results: The prevalence of adenomyosis was 37.1%. The sensitivity and specificity of these results were 80.8% and 61.4%. The positive (PPV) and negative (NPV) predictive values were 55.3% and 84.4%. Diagnostic accuracy by transvaginal sonography for adenomyosis was 68.6%. The highest accuracy for the diagnosis of adenomyosis was globular appearing uterus, subendometrial echogenic linear striations and myometrial cysts. In the diagnosis of adenomyosis among transvaginal ultrasound findings, the subendometrial linear striations had the highest diagnostic accuracy. Heterogeneous myometrium was the most common in patients with adenomyosis but with poor specificity. The most specific sonographic features were (95.5%) in the subendometrial linear striations which also had the highest PPV (80.0%) for the diagnosis of adenomyosis. All the results have been supported by statistical tests.
Conclusions: Transvaginal ultrasound technique proved to be the very good diagnostic tools for the diagnosis of adenomyosis.

Keywords: TVS, Adenomyosis, Histopathology, Hysterectomy, NPV, PPV

INTRODUCTION

Adenomyosis is a common gynecological disorder, defined by the presence of ectopic endometrial glands and stroma within the myometrium associated with hypertrophy and hyperplasia of surrounding adjacent myometrium.[1] It is also clinically associated with dysmenorrhea, dyspareunia and menometrorrhagia. However, these clinical findings are generally non-specific and are often seen in other conditions, such as leiomyoma, endometriosis, endometritis or endometrial polyps.[2] Therefore, it needs sonographic and histopathologic diagnosis in addition to clinical diagnosis of adenomyosis to confirm treatment and follow up.

According to yet published articles on hysterectomy, adenomyosis prevalence varies from 0.5 to 70%.[3,4] In addition to clinical findings, now-a-days, two important non-invasive techniques such as transabdominal and transvaginal sonography are using randomly to diagnose adenomyosis.[5,6] But, transvaginal sonographic techniques are proved to be superior to transabdomoninal. The sensitivity and specificity of transabdominal and transvaginal ultrasound are 52–89% and 57–97.5%, respectively.[7-10] Transabdominal ultrasound diagnostic capacity for adenomyosis is low in women with leiomyomas.[2,11,12] For these reason, transvaginal ultrasound techniques have been improved.

All sonographic features of adenomyosis like increased myometrial echotexture, asymmetry of the anterior-posterior wall thickening, various size and shaped anechoic cyst-lacunae, ill-defined and heterogenous myometrial circumscribed areas are common in adenomyometous uteri.[2,7,13,14] But general agreement on the most specific transvaginal ultrasound diagnostic features yet not established. Therefore, our main focus was to compare the accuracy of preoperative transvaginal ultrasound examination correlated with histopathological results in adenomyosis diagnosis and to determine its sensitivity, specificity and positive (PPV) and negative predictive values (NPV).

METHODS

This prospective study was conducted from January 2024 to September 2024, 140 consecutive patients referred to Bangabandhu Sheikh Mujib Medical University (BSMMU), Shahbagh, Dhaka and Islami Bank Hospital at Mirpur Dhaka for hysterectomy had preoperative transvaginal ultrasound examinations performed by the author herself with 21-years' experience. The patient ages ranged from 36 to 64, mean age 50.05 years with standard deviation (SD) 5.57. All patients underwent ultrasonography by Toshiba model Xario 100 Platinum, 2014, system ID: 10NN07ET well equipped with a 5-MHz endovaginal transducer. During each examination, the uterine borders (regular or irregular), uterine size, myometrial echotexture were noted.

Inclusion criteria

Clinically indicated cases of hysterectomy and histopathologically confirmed cases of adenomyosis were the study group.

The following transvaginal sonographic findings were regarded as adenomyosis.[2,5-12]

Heterogenous myometrial echotexture, globular appearing uterus, asymmetrical anteroposterior myometrial wall thickness, subendometrial cysts and echogenic linear striations with poor endo-myometrial junction, myometrial cyst of 1–7 mm; subendometrial echogenic linear striations being hyperechoic and located near the endometrial–myometrial interface; heterogeneous myometrium defined by the presence of an indistinctly defined myometrial area with decreased or increased echogenicity.

Exclusion criteria

Indication of hysterectomy for any type of cancer cases were excluded from the study.

All printed sonographic images were re-evaluated. All sonographic findings were compared with the histopathological results.

All histopathological examinations were performed by the experienced same pathologist who was blinded to the sonographic findings using Olympus microscope of Model CX41. Macroscopic appearance such as uterine size, lumen and associated pathological abnormalities were recorded during gross examination. Required block sections were taken.

Macroscopic diagnosis of adenomyosis was done by globular enlarged asymmetrical uterus and macroscopic small cavities (0.5–10 mm). Circumscribed focal nodular or diffuse lesion was also regarded as adenomyosis macroscopically.

Presence of ectopic endometrial glands and/or stroma in the myometrium located 2.5 mm beyond the endometrial–myometrial junction under a low-power microscope was considered diagnostic of adenomyosis.

Individual findings and final diagnosis analysis was performed by sensitivity, specificity, NPV, PPV and accuracy test. In order to test the association between the attributes pairwise, Chi-square (χ^2) test has been performed. In each case, significance value (p values) were used at 5% and 1% level of significance. Statistical analysis was performed using statistical package for the social sciences (SPSS) of its version 22.0.

RESULTS

A total of 140 cases of hysterectomy indicated cases were studied. The patients ages ranged from 36 to 64 with mean=50.05 years with standard deviation (SD) =5.57. In this study, 104 women were premenopausal (74.3%) and 36 were postmenopausal (25.7%). Leiomyoma of the uterus was the most common single indication for hysterectomy 56 (40%). Other indications were endometrial hyperplasia 36 (25.4%), adnexal tumours 16 (11.43%) premenopausal abnormal uterine bleeding 16 (11.43%), uterine prolapse 4 (2.86%), cervical dysplasia 4 (2.86%) and postmenopausal bleeding 4 (2.86%).

Histopathological findings

Adenomyosis was found in 52/140 (37.1%) patients at the histological examination. Fundal, posterior, anterior, right-

sided and left-sided adenomyosis cases were eighteen, fourteen, ten and six respectively. Various other disorders with or without adenomyosis were detected including endometrial hyperplasia in 36 cases (25.7%), leiomyoma in 56 patients (40%), ovarian cancer in four cases, ovarian mature cystic teratoma in four cases, serous ovarian cyst in four cases, endometriosis in four cases and cervical dysplasia in four cases (Table 1).

Table 1: Demographic characteristics of our study participants (n=140).

Characteristics	N (%)
Age (years)	Mean±SD: 50.05±5.57
Age range	36–64 years
Menopausal status	
Premenopausal	104 (74.3)
Postmenopausal	36 (25.7)
Indications for hysterectomy	
Leiomyoma	56 (40.0)
Endometrial hyperplasia	36 (25.7)
Adnexal tumors	16 (11.4)
Premenopausal AUB	16 (11.4)
Uterine prolapse	4 (2.9)
Cervical dysplasia	4 (2.9)
Postmenopausal bleeding	4 (2.9)

Sonographic findings

Transvaginal ultrasound was diagnostic of adenomyosis in 76 of the 140 patients. Among 76 transvaginally diagnosed patients, 42 (55.3%) of these had a histopathological diagnosis of adenomyosis and rest 34 patients were not diagnosed as adenomyosis by microscopic examination. So, these 34 patients were regarded as false positive for transvaginal ultrsonography. Of the 64 cases in which none of the transvaginal ultrasound diagnostic criteria for adenomyosis were seen. But among these 64 patients not diagnosed as adenomyosis by transvagiinal ultrasonography, ten (15.7%) had a histopathological diagnosis of adenomyosis (ten false-negative diagnoses for transvaginal ultrasonography). Transvaginal ultrasound yielded a diagnosis of adenomyosis in 42 of the 52 women diagnosed histologically (Table 2).

The sensitivity, specificity, PPV and NPV of transvaginal ultrasound in the diagnosis of adenomyosis were 80.77, 61.36, 55.26 and 84.38%, respectively. The overall accuracy of transvaginal ultrasound was 68.57%. Enlarged uterus, myometrial heterogeneity, cysts and subendometrial linear striations in the myometrium showed higher statistical significance ($p<0.01$) than myometrial anteroposterior asymmetry and identification of endomyometrial junction ($p<0.05$) at 1% and 5% level of significance (Table 3).

Table 4 shows various transvaginal sonographic findings (sensitivities, specificities, PPVs, NPVs and accuracies). Sensitivity was found to be highest in myometrial heterogeneity. Although the prevalence of subendometrial echogenic linear striations was the lowest in patients with adenomyosis (30.8%), this finding was the most specific criterion and had the highest PPV. On the other hand, accuracy was high in myometrial cysts, enlargement of the uterus and sub-endometrial echogenic linear striations.

Table 2: Comparison of adenomyosis patients diagnosed preoperatively by transvaginal ultrasound (TVS) with histopathology results.

TVS adenomyosis	Histopathological adenomyosis (N)		
	Yes	**No**	**Total**
Yes	42	34	76
No	10	54	64
Total	52	78	140

Table 3: Comparison of transvaginal ultrasound for adenomyosis with histopathology results.

Variables	Histopathological adenomyosis (N (%))		Chi-square (χ^2) test (p value)
	Yes (n=52)	**No (n=88)**	
Globular configuration			
Yes	36 (69.2)	12 (13.6)	0.001**
No	16 (30.8)	76 (86.4)	
Myometrial anteroposterior asymmetry			
Yes	32 (61.5)	32 (36.4)	0.041*
No	20 (38.5)	56 (63.6)	
Identification of endomyometrial junction			
Yes	24 (46.2)	16 (18.2)	0.012*
No	28 (53.8)	72 (81.8)	
Sub-endometrial echogenic linear striations			
Yes	16 (30.8)	4 (4.5)	0.002*
No	36 (69.2)	84 (95.5)	
Myometrial cysts			
Yes	32 (61.5)	16 (18.2)	0.001**
No	20 (38.5)	72 (81.8)	
Heterogeneous myometrium			
Yes	42 (80.8)	34 (38.6)	0.001**
No	10 (19.2)	54 (61.4)	

*Statistically significant at 5% level of significance, **statistically significant at 1% level of significance

Classification of adenomyosis was done according to size, uterine location and the depthness into the myometrium. The sonographic location of adenomyosis was in accordance with the histopathological findings in 42 true-positive cases. However, using the 'superficial–deep–entire' grading system, the histological and transvaginal ultrasound grading were found to be in accordance in only 26 of these (62%). In the 'mild–moderate–severe' grading system, these grading were in accordance in only twelve cases (29%). Ultimately, transvaginal ultrasound grading of adenomyosis did not correlate with the histopathological grading.

Table 4: Sensitivity, specificity, PPV and NPV of transvaginal ultrasound findings for the diagnosis of adenomyosis in our series.

Sonographic findings	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Globular configuration	69.20	86.39	75.0	82.59	80.0
Myometrial anteroposterior asymmetry	61.5	63.60	50.0	73.7	62.9
Identification of endomyometrial junction	46.21	81.8	60.0	72.0	68.6
Subendometrial echogenic linear striations	30.78	95.5	80.0	70.0	71.4
Myometrial cysts	61.5	81.8	66.7	78.3	74.3
Heterogeneous myometrium	80.79	61.4	55.3	84.4	68.59

DISCUSSION

According to histopathological examination of hysterectomy specimens, adenomyosis is one of the most common uterine diseases. The reported frequency varies widely, from 0.5 to 70%.[3-6] This is very wide range histopathological results. This is due to results of differences in histological criteria in adenomyosis diagnosis, quality of pathological specimens examined and sampling sites number considered in previous studies.[2,6,12-14] Diagnostic rates in the same uteri varied between 31% and 62% in one series which is depend on the sample number obtained.[15] But our study showed undetermination of the actual frequency of adenomyosis. This was because of only four to six blocks obtained per specimen.

Adenomyosis is generally associated with leiomyoma, endometrial hyperplasia, adenocarcinoma or other pathological conditions. The data support the concept that adenomyosis is a hormone-dependent disorder, as it is associated with persistently elevated estrogen levels.[12,16] Bazot et al found that adenomyotic uteri were accompanied by additional pelvic disorders in 82.5% of the cases in their study.[12] In our study, adenomyotic uteri were accompanied by leiomyomas in 38.5% of cases, and secondarily endometrial hyperplasia in 30.8% of cases.

Bazot et al found that the diagnosis of adenomyosis with high accuracy by transvaginal ultrasound technique.[2] In this study, it showed that the sensitivity and specificity were 65.01% and 97.52% respectively. PPV and NPV of transvaginal sonography for adenomyosis were 92.8% and 88.8%. In another study of Bazot et al the sensitivity, specificity and accuracy of transvaginal ultrasound for the diagnosis of adenomyosis in selected patients who had menometrorrhagia but no evidence of endometrial disease and leiomyomata were 80.93%, 100% and 82.62%, respectively. In contrast, transvaginal ultrasound was found to have a poor sensitivity (38.4%) in unselected patients who were scheduled for hysterectomy.[12]

The discrepancy in the accuracy of transvaginal ultrasound could be explained in part by patient characteristics. TVS accuracy was poor in Bazot et al, study of patients with an enlarged uterus. It is because of incomplete uterine evaluation.[12] Reinhold et al reported a specificity as high as 86% for transvaginal ultrasound in their study in 1995 and similar diagnostic efficiencies with transvaginal ultrasound and MRI.[9,10]

In one study of Ascher et al proposed that MRI may be the choice of diagnosis of adenomyosis, especially in women with myoma.[8] Bazot et al study found that the sensitivity and specificity of MRI for the diagnosis of adenomyosis were 77.52% and 92.53% respectively.[2] However, the diagnostic accuracy of transvaginal ultrasound is lower than that of MRI in women with associated disorders but similar accuracy in case of adenomyosis only.[2,8,10,13]

The sensitivity and specificity of the present study were more or less similar with other some studies. The specificity in our study was lower than that of other studies. It could be explained by the inclusion criteria of patients with other disorders associated with adenomyosis. It could be due to insufficient sonographic resolution and difference of the study techniques.

Table 5: Sensitivity, specificity, PPV and NPV of transvaginal ultrasound for the diagnosis of adenomyosis from previous series compared with the series of present study.[2,7-10,12-14,17,18,21]

Reference	N	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Siedler et al[17]	80	63	97	71	80
Fedele et al[7]	43	80	74	73	81
Ascher et al[8]	17	52.9	66.6	90	20
Reinhold et al[9]	100	86	86	71	94
Brosens et al[18]	34	86.6	57.9	61.9	84.6
Atzori et al[21]	175	86.6	96.2	68.4	98
Reinhold et al[10]	119	89	89	71	96
Vercellini et al[13]	102	82.7	67	50	90.7
Atri et al[14]	102	81	71	54	90
Bazot et al[2]	120	65	97.5	92.8	88.8
Bazot et al[12]	23/106	80.9/38.4	100/97.5	100/83.3	40/82.9
This study	140	80.77	61.36	55.26	84.4

There is variable accuracy of sonography for the diagnosis of adenomyosis. This is probably due to different selected diagnostic criteria. In most studies, myometrial heterogeneity was the main criterion used for diagnosing adenomyosis. It might be correlated with a smooth-muscle hypertrophic-hyperplasia reaction.[8-10,13,18] Bromley et al showed that every patient with adenomyosis was mottled heterogeneous uterus.[19] According to their study, 95.5% were globular uterus, 82% with myometrial lucency and 82% indistinct endometrial stripe.

Bazot et al found that myometrial cyst was the most sensitive and specific finding for adenomyosis and poor accuracy in heterogeneous myometrium among the sonographic criteria.[2,12] Fedele et al were the first who reported the value of myometrial anechoic lakes for the diagnosis of adenomyosis.[7] They showed that sensitivity and specificity of these sonographic findings were 80 and 74%, respectively in case of women without leiomyoma or endometrial disease. According to the study of Atri et al subendometrial echogenic linear striations, subendometrial echogenic nodules and asymmetrical myometrial thickness were the best specificity and PPVs in the diagnosis of adenomyosis.[14] But our study showed that subendometrial echogenic linear strations was the highest specificity and PPV. Thus, we consider these findings to be the most specific findings for differential diagnosis. This is similar to the study of Atri et al.[14]

Our study had two main limitations. One was the restriction of the study population to women with only due to be hysterectomized and another lack of exclusion of patients with multiple or large myomas that distorted the uterus. Leiomyoma was the main indication for hysterectomy. Therefore, it was a more difficult task to pinpoint the accuracy of transvaginal ultrasound diagnosis of adenomyosis.

CONCLUSION

Transvaginal ultrasound technique proved to be the very good diagnostic tools for the diagnosis of adenomyosis. However, this study suggests that subendometrial linear striations, a regularly enlarged uterus with a globular appearance and myometrial cysts have the highest specificity and PPV. But it has the lower sensitivity compared with heterogeneous myometrium for the diagnosis of adenomyosis.

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