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Transvaginal Sonographic Evaluation of Adenomyosis, Leiomyoma or Combined Adenomyosis and Leiomyoma: Association with Histopathological Outcomes

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Abstract

This prospective study was conducted in the Department of Histopathology and Radiology and Imaging of the Islami Bank Hospital, Mirpur and the Department of Radiology and Imaging, BSMMU Dhaka to evaluate the accuracy, sensitivity, specificity, positive and negative predictive value (PPV& NPV) for the diagnosis of adenomyosis, leiomyoma, or combined adenomyosis and leiomyoma by the use of transvaginal ultrasonography (TVS) compared to the histopathological findings. Transvaginal sonography is a popular method to diagnose adenomyosis, leiomyoma or combined adenomyosis and leiomyoma which ultimately lead to hysterectomy followed by histopathology. One hundred patients were scheduled for hysterectomy after preoperative transvaginal sonography. All sonographic findings were compared with the histopathological results.The symptomatic patients were diagnosed as adenomyosis, leiomyoma or both by transvaginal ultrasound (TVS) technique. These diagnosed patients routinely underwent hysterectomy or myomectomy with excision of surrounding myometrium. Following surgery, histopathology of hysterectomy or myomectomy specimens were done by the experienced pathologists. TVS diagnosis of adenomyosis was sensitive but not highly specific. TVS was more sensitive, specific and accurate in the diagnosis of leiomyoma or combined adenomyosis and leiomyoma. Our study suggests that TVS is a very valuable noninvasive method that can be utilized in the diagnosis of leiomyoma or combined adenomyosis and leiomyoma. TVS is sensitive but not specific in the diagnosis of adenomyosis only. This study also suggests that histopathology werethe 'gold standard' for the diagnosis of adenomyosis, leiomyoma or combined adenomyosis and leiomyomabased on the accuracy, sensitivity, specificity, positive and negative predictive value (PPV& NPV). It is evident that there is a strong association between transvaginal sonographic evaluation of adenomyosis, leiomyoma or their combination with histopathological findings ($p<0.05$).

Keywords: Adenomyosis; Histopathology; Leiomyoma; Transvaginal ultrasound

Introduction

Adenomyosis is a common gynecological problem usually in female reproductive life. It is characterized by ingrowths of endometrial glands and stroma into the myometrium. Leiomyoma are commonly associated with adenomyosis. Both adenomyosis and leiomyoma are benign in nature. These conditions are usually responsible for uterine enlargement, menorrhagia, anemia, and infertility [1].

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Uterine leiomyomas are the most common pelvic neoplasm in female. They are noncancerous monoclonal tumors arising from the smooth muscle cells and fibroblasts of the myometrium.

On a sonography, adenomyosis diffusely enlarged uterus with an inhomogeneous texture, small cystic spaces, and an indistinct endometrial stripe, while leiomyoma appear as a well-defined mass. On the other hand, histopathological adenomyosis can be clearly defined by endometrial glands and stroma in the myometrium, while leiomyoma appears as a concentric and interlacing bundles of benign smooth muscle proliferation. Because of it's to some extent similarities to leiomyoma, sometimes it might be difficult to diagnose adenomyosis accurately by ultrasound. The treatment and prognosis of adenomyosis and leiomyoma are different.

Most gynecologists consider conservative management for adenomyosis, while surgical intervention is the priority in case of leiomyoma or combined adenomyosis and leiomyoma.

Now a days, three most common methods such as magnetic resonance imaging (MRI), transabdominal ultrasonography (TAS) and transvaginal ultrasonography (TVS) are using for the diagnosis of adenomyosis[2]. TVS has more feasible option but limited diagnostic capacity with TAS [3-6]. TVS is much more cost effective and readily available than MRI.

In the light of above context, the aim of our prospective study was to determine the accuracy, sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of TVS in the diagnosis of adenomyosis and leiomyoma with confirmation of postsurgical histopathological outcomes. An accurate noninvasive diagnostic method like ultrasound for adenomyosis, leiomyoma, or combined is an utmost ongoing need for the gynecologist [7].

Methods

This prospective study was done during the period of January 2024 to December, 2024. Patients underwent surgery for the treatment of adenomyosis, leiomyoma, or combined adenomyosis and leiomyoma. A preoperative TVS was administered in each patient. This study was conducted in the Department of Histopathology and Radiology and Imaging of the Islami Bank Hospital, Mirpur and the Department of Radiology and Imaging, BSMMU Dhaka. All patients underwent ultrasonography by Toshiba model Xario 100 Platinum, 2014, system ID: 10NN07ET well equipped with a 5-MHz endovaginal transducer. Diagnostic criteria of uterine adenomyosis include two of the five sonographic features on TVS [5,8-11] (1) No distinction of the endometrial-myometrial junction, (2) asymmetry of the anterior and posterior myometrium; (3) subendom-myometrial striations, (4) myometrial cysts and fibrosis and (5) heterogeneous myometrial echotexture.

Inclusion criteria of uterine leiomyoma were two of the five sonographic features on TVS: (1) Clear demarcation of the tumor margin, (2) whorl appearance of the tumor, (3) Presence of blood vessels (by color Doppler) surrounding the tumor, (4) Irregularities of the uterine outer surface and intramural region of wall (subserous and intramural tumors) and (5) Irregularities of the endometrial surface (submucous tumors type 1 and 2).

Patients diagnosed with adenomyosis or combined adenomyosis and leiomyoma via TVS underwent hysterectomy and myomectomy. Symptomatic patients diagnosed with adenomyosis and leiomyoma via TVS underwent myomectomy with excision of the surrounding myometrium. Following surgery, a histopathological examination was performed by the hospital pathologists. All histopathological examinations were performed by an experienced 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 blocks were taken.

Macroscopic diagnosis of adenomyosis was done by globular enlarged asymmetrical uterus and macroscopic small cavities (0.5–10 mm).

Ectopic endometrial glands and/or stroma in the myometrium located 2.5 mm beyond the endometrial–myometrial junction under a low-power microscope considered as adenomyosis. Proliferated and interlacing bundles of smooth muscles mostly whorled appearance without atypia under light microscope were considered as leiomyoma uterus. The microscopic diagnosis of the specimen was recorded.

Sensitivity, specificity, NPV, PPV and accuracy were determined for ultrasound findings as they corresponded with the final histopathological diagnosis. In order to test the association between transvaginal sonographic evaluation of adenomyosis, leiomyoma or their combination with histopathological findings, Chi-square (χ^2) test of independence has been performed at 5% level of significance. Statistical analysis was performed by using SPSS of its version 22.0.

Results

From January 2024 to December 2024, 100 patients underwent surgery for the treatment of adenomyosis, leiomyoma, or combined adenomyosis and leiomyoma. Of 100 patients, 80 TVS-diagnosed patients of adenomyosis or leiomyoma or adenomyosis with leiomyoma underwent hysterectomy and rest 20 patients were diagnosed as adenomyosis, leiomyoma or combined adenomyosis and leiomyoma underwent myomectomy. The patients ranged in

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age from 27 to 68 years. The mean age was 43.6 years with a standard deviation (SD) of 6.5 years and median of 43 years.

Preoperatively, by TVS75 patients were diagnosed as adenomyosis, 82patients as leiomyoma and 58patients as both adenomyoasis and leiomyoma.

Table 1 shows the correlation between TVS positive findings of adenomyosis, leiomyoma and combined adenomyosis and leiomyoma with histopathological results. Of the 75 patients (75%) who were positively diagnosed with adenomyosis by TVS, 57 of the patients' (75.61% PPV, n=75) diagnoses were confirmed by the histopathological findings. The other 18 patients (24%, n=75) had a negative histopathological diagnosis.

Eighty two patients (82%, n=100) were diagnosed with leiomyoma and 18 patients (18%) were negative for leiomyoma upon the initial TVS. Of the 82 (82%) patients diagnosed with leiomyoma by TVS, 81 (98.78% PPV, n=82) were confirmed as leiomyoma histopathological and in one patient's (1.21%, n=82) pathology report did not confirm the diagnosis.

Of the 58 patients (58%, n=100) that were positively diagnosed with combined adenomyosis and leiomyoma by TVS, 44 (75.86% PPV, n=58) had histopathological confirmation of both conditions and 14 patients (24.14%, n=58) did not have evidence of both conditions in their post-surgical pathology report.

It is evident from the Chi-square (χ^2) test of independence that there is a strong association between transvaginal sonographic evaluation of adenomyosis, leiomyoma or their combination with histopathological findings ($p<0.05$) at 5% level of significance.

Table 2 shows the correlation between TVS negative findings of adenomyosis, leiomyoma and combined adenomyosis and leiomyoma with histopathological results. Among 100 total patients, twenty five patients (25%, n=100) were not diagnosed as adenomyosis by TVS. Of the 25 patients negative for adenomyosis, histopathological reports found 14 (57.50% NPV, n=25) confirmed negative diagnosis and 11 (42.50%, n=25) positive findings.

The sensitivity of TVS in the diagnosis of adenomyosis was 84.55% (95% CI 76.4-90.7, $P<0.0001$) and the specificity was 43.40% (95% CI 29.8-57.7, $P = 0.41$).

Of the 18 patients whose TVS diagnosis was negative for leiomyoma,15 (82.76%, n=18) patients' histopathological findings were also negative but only three patients (17.24%, n=18) were histopathological positive.

The sensitivity and specificity of TVS as a diagnostic test for leiomyoma was 96.38% (95% CI 91.75-98.81) and 96.00% (95% CI 79.65-99.90) respectively. This study suggests that positive diagnosis of leiomyoma by TVS are 24.09 times (95% CI 35.30-164.45, $P = 0.001$) more likely to have leiomyoma condition. But patients with negative for the diagnosis of leiomyoma by TVS are 26.53 times (95% CI 11.16-62.89, $P < 0.0001$) less likely to have leiomyoma. The accuracy of TVS in the diagnosis of leiomyoma was 96.32%.

Of the 100 patients, 42 patients had a negative TVS diagnosis for combined adenomyosis and leiomyoma. Of the 42 TVS negative patients for combined adenomyosis and leiomyoma, 29 ((71.01% NPV, n=42)) were histopathological negative. However, 13 patients (28.99%, n=42) had positive histopathological diagnosis for both adenomyosis and leiomyoma.

The TVS sensitivity and specificity in the diagnosis of combined adenomyosis and leiomyoma was 77.78

Table 1: Association between TVS positive findings of adenomyosis, leiomyoma and combined adenomyosis and leiomyoma with histopathological results.

Diseases	TVS positive (n=100)	Histopathological findings		Chi-square (χ^2) test results (p-value)
		Positive	Negative	
Adenomyosis	75 (75.0%)	57 (75.61%)	18 (24.39%)	0.003
Leiomyoma	82 (82.0%)	81 (98.78%)	01 (1.21%)	0.000
Combined adenomyosis & leiomyoma	58 (58.0%)	44 (75.16%)	14 (24.14%)	0.000

Table 2: Correlation between TVS negative findings of adenomyosis, leiomyoma and combined adenomyosis and leiomyoma with histopathological results.

Diseases	TVS Negative (n=100)	Histopathological findings	
		Positive	Negative
Adenomyosis	25 (25%)	11 (42.50%)	14 (57.50%)
Leiomyoma	18 (18%)	03 (17.24%)	15 (82.76%)
Combined adenomyosis & leiomyoma	42 (42%)	13 (28.99%)	29 (71.01%)

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(95% CI 67.79-85.87) and 67.12% (95% CI 55.13-77.67) respectively. Patients who were positive TVS diagnosis are 2.37 times (95% CI 1.67-3.34, $P < 0.0001$) more likely to be diagnosed with combined adenomyosis and leiomyoma. Alternatively, patients who are negatively diagnosed with adenomyosis and leiomyoma by TVS are 3.02 times (95% CI 1.99-4.59, $P < 0.0001$) less likely to be diagnosed with combined adenomyosis and leiomyoma. The TVS accuracy in the diagnosis of combined adenomyosis and leiomyoma was 73.00% (Table 3).

This study suggests that in the diagnosis of adenomyosis, TVS is sensitive but not specific. This can be described by the difficulty to diagnose adenomyosis patients along with other intrauterine abnormalities. Patients positively diagnosed with adenomyosis via TVS are 1.49 (95% CI 1.16-1.92, $P < 0.002$) times more likely to have the actual condition. Conversely, patients negatively diagnosed with adenomyosis via TVS are 2.81 (95% CI 1.65-4.79, $P = 0.0002$) times less likely.

Discussion

Adenomyosis is a common gynecological disorder. It is characterized by the infiltration of the endometrium into the underlying myometrium. Clinically, difficulty in the diagnosis ofadenomyosis is due to the lack of strong positive pathologic signs and clinical findings [12]. The frequency of adenomyosis in the reproductive female is reported to be varies widely from 8 to 85% [4,7-11,13]. This variation was explained by Azziz et al who showed the result of differences in the histological criteria for the diagnosis of adenomyosis[14]. Different accuracy measurements were calculated for the diagnosis of adenomyosis, leiomyoma, and combined adenomyosis and leiomyoma. TVS was 71.17% accurate in the diagnosis of adenomyosis.

A comparison of sensitivity, specificity, PPV, and NPV of this study with several previous studies that investigated the diagnosis of adenomyosis [4,5,7-11,13,15-18] has been shown in Table 4.

Table 3: Number of patients, positive and negative predictive values, sensitivity, specificity, and accuracy of transvaginal ultrasound for initial diagnosis with histopathological correlation

TVS Diagnosis	Number	PPV(%)	NPV (%)	Sensitivity (%)	Specificity (%)	Accuracy (%)
Adenomyosis	75	75.61	57.50	84.55	43.40	71.17
Leiomyoma	82	99.25	82.76	96.38	96.00	96.32
Combined adenomyosis and Leiomyoma	58	74.47	71.01	77.78	67.12	73.00

PPV=positive predictive value, NPV= Negative predictive value, TVS=Transvaginal ultrasonography

Table 4: Comparison of sensitivity, specificity, PPV, and NPV of this study with several previous studies that investigated the diagnosis of adenomyosis.

References	Number	Sensitivity (%)	Specificity(%)	PPV (%)	NPV(%)
Seidler et al. [15]	80	63.0	97.0	71.0	
Fedele et al. [10]	43	80.0	74.0	73.0	81.0
Ascher et al. [10]	17	62.9	66.6	90.0	20.0
Reinhold et al. [11]	100	86.0	86.0	71.0	94.0
Brosens et al. [7]	34	86.6	57.9	61.9	84.9
Atzori et al. [4]	175	86.6	96.2	68.4	98.0
Reinhold et al. [9]	119	89.0	89.0	71.0	96.0
Vercellini et al. [16]	102	82.7	67.0	50.0	90.7
Atri et al. [17]	102	81.0	71.0	54.0	90.0
Bazot et al. [8]	120	65.0	97.5	92.8	88.8
Bzaot et al. [5]	23/106	80.9/38.5	100/97.5	100/83.3	40/82.9
KepKep et al. [18]	70	80.8	61.4	55.3	84.4
This study (2024)	100	84.5	43.3	75.5	57.4

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It is important to note that the mean number of patients included in the 12 previous studies in the Table 4 was 76.7 patients. This study was carried out with 100 patients, and their diagnoses results have been included in the analyses. Differences in criteria of inclusion, criteria of adenomyosis diagnosis, quality of ultrasound equipment and the differences in the larger or smaller sample size might be responsible for differences in results.

The TVS sensitivity and specificity for the diagnosis of adenomyosis in this study was 84.55 and 43.40% respectively. It is indicating that TVS as a diagnostic tool is sensitive, but not specific in the diagnosis of adenomyosis. The sensitivity of our study was more or less similar to those previously reported showed ion Table 4. But the specificity was the lowest in comparison to other studies. This could be due to the difficulty in the diagnosis of adenomyosis in the presence of other uterine abnormalities.It is found especially in uterine leiomyomata which distort the uterus. Patients diagnosed with multiple intrauterine abnormalities were not excluded from this study.

In our study, theTVS sensitivity for the diagnosis of leiomyoma was 96.38% and the specificity was 96.00%, which is similar to that of a previous study [19]. The accuracy of TVS in the diagnosis of leiomyoma was 96.32%. The accuracy of TVS in the diagnosis of combined adenomyosis and leiomyoma was 73.00%. The sensitivity and specificity for the diagnosis of combined adenomyosis and leiomyoma was 77.78% and 67.12% respectively.

TVS is a very useful diagnostic tool in the diagnosis of adenomyosis. It was accurate, sensitive, and specific in the diagnosis of leiomyoma and combined adenomyosis and leiomyoma. TVS was both accurate and sensitive in the diagnosis of adenomyosis, but not specific. However, TVS is cost effective and readily available in the majority of gynecologists.

Conclusion

This study demonstrated that TVS is a very valuable noninvasive method. It can be utilized in the diagnosis of leiomyoma as well as combined adenomyosis and leiomyoma. Although TVS is sensitive, but not that much specific in the diagnosis of adenomyosis only.

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