

# DIAGNOSTIC ACCURACY OF TRANSVAGINAL ULTRASONOGRAPHY IN DIAGNOSING ADENOMYOSIS, TAKING MAGNETIC RESONANCE IMAGING FINDINGS AS GOLD STANDARD

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## ABSTRACT

**OBJECTIVES:** To determine the diagnostic accuracy of transvaginal ultrasonography in diagnosing adenomyosis, taking magnetic resonance imaging findings as gold standard. **STUDY DESIGN:** Cross-sectional validation study. **SETTINGS:** Department of Radiology, armed forces institute of radiology and imaging (AFIRI). **STUDY DURATION:** 1<sup>st</sup> January 2023 to 30 September 2023. **METHODOLOGY:** A total of 129 patients with suspected adenomyosis and the ages between 25-55 years were included. Patients who have uterine fibroids, intrauterine contraception device were excluded. Then in all patients, transvaginal sonography with 7 MHz probe was performed using standard technique in the presence of female staff. Each ultrasound findings was looked for adenomyosis (present/absent). All patients were then undergone magnetic resonance imaging which was performed on a 1.5-T system with T2-weighted spin-echo or T2-weighted turbo spin-echo (TSE) sequences. Each MRI findings was interpreted by one consultant radiologist and was looked for adenomyosis (present/absent). Ultrasonography findings were compared with MRI findings. **RESULTS:** Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of transvaginal ultrasonography in diagnosing adenomyosis, taking magnetic resonance imaging findings as gold standard was 94.12%, 89.83%, 91.43%, 92.98% and 92.13% respectively. **CONCLUSION:** This study concluded that diagnostic accuracy of transvaginal ultrasonography in diagnosing adenomyosis is quite high, and has not only dramatically improved our ability of diagnosing adenomyosis but also helps the clinicians for proper management plans.

**Keywords:** adenomyosis, transvaginal ultrasound, sensitivity.

## Introduction

Adenomyosis is a benign condition of the uterus caused by a proliferation of endometrial glands and stroma leading to ill-defined lesions within the myometrium. The displaced glands cause spiral vessel angiogenesis and smooth muscle hyperplasia and

hypertrophy. Thickening of the junctional zone and uterine enlargement can result. Causes include invasion of endometrial glands into the myometrium, displaced pluripotent mullerian remnants, invagination of the endometrium through the basalis along lym-

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phatics, and displaced bone marrow stem cells.<sup>1</sup> On the basis of myometrial invasion extension, adenomyosis can be classified as either diffuse or focal. In the diffuse type, endometrial glands and/or stroma are extensively intermingled with myometrial muscle fibers, with an increase in uterine volume (proportionally correlated with the extent of lesions); focal adenomyosis is generally a single nodular aggregate located in the myometrium.<sup>2</sup>

Patients with adenomyosis can have a range of clinical presentations. The most common symptoms of adenomyosis are menorrhagia, dysmenorrhea, pelvic pain, and uterine enlargement; however, adenomyosis is asymptomatic in one third of cases.<sup>3</sup> Women with adenomyosis often have other associated gynecologic conditions, such as endometriosis or leiomyomas, therefore making the diagnosis and evaluating response to treatment challenging.<sup>4</sup> There is an increased risk of adenomyosis in women with increased parity, early menarche, short menstrual cycles, high body mass index, prior dilatation and curettage, and prior cesarean delivery.<sup>1</sup>

Unfortunately, the diagnosis can be difficult especially when it's associated with other gynecological pathologies. Adenomyosis cannot be accurately diagnosed on clinical criteria alone.<sup>2</sup> Yet, hysterectomy is frequently performed merely on the basis of suspected symptoms. Better preoperative diagnostic tools are required to avoid unnecessary hysterectomy and, if possible, to investigate nonsurgical alternatives.<sup>3</sup>

Several studies have evaluated the accuracy of transvaginal ultrasonography (TVS) for the diagnosis of adenomyosis.<sup>3-5</sup> However, a comprehensive picture of the diagnostic precision of TVS is still lacking because patients have often been selected on the basis of either clinical symptoms or uterine masses where the prevalence of adenomyosis is high, or studies have differentiated only between adenomyomas and myomas, not accounting for diffuse adenomyosis. The sonographic findings in adenomyosis include presence of myometrial hypoechoic striations or myometrial cyst or heterogeneous areas, asymmetry of myometrial wall, diffuse vascularity and globular uterine configuration.<sup>5-8</sup> In a study, prevalence of adenomyosis was found to be 58.97% and transvaginal sonography had a sensitivity of 89.13% and specificity of 90.62% in diagnosing adenomyosis.<sup>7</sup>

Another study has shown the sensitivity and specificity of transvaginal ultrasonography in diagnosing adenomyosis as 91.8% & 36.8% respectively.<sup>8</sup>

Previously limited studies are available on this topic and also these studies have shown variable results. The rationale of this study is to determine the diagnostic accuracy of transvaginal ultrasonography in diagnosing adenomyosis, taking magnetic resonance imaging findings as gold standard. If its diagnostic accuracy will be found high, then this modality can be applied routinely in our general practice for these particular patients for accurate and timely diagnosis of adenomyosis and our population can be provided with an efficient, easily available and safe modality. Then based on the results of our study, a protocol can be designed for early screening and diagnosis of adenomyosis in these particular patients which will help the clinicians for selection of proper treatment option in order to reduce the morbidity of these patients.

## Methodology

The study was conducted by the department of Radiology at armed forces institute of radiology (AFIRI) from 1<sup>st</sup> Jan 2023 to 30<sup>th</sup> September 2023. After approval from institutional ethical review committee. Sample size was calculated by using sensitivity specificity calculator taking prevalence of adenomyosis= 58.97%,<sup>7</sup> Sensitivity = 89.13%, Specificity = 90.62%, Margin of error= 8 % and Confidence level= 95 % of transvaginal sonography in diagnosing adenomyosis.<sup>7</sup>

Total number of 129 female patients presented to the Radiology department of armed forces institute of radiology and imaging (AFIRI) Rawalpindi, fulfilling the inclusion criteria were selected. Informed consent from each patient was taken. Then in all patients, transvaginal sonography with 7 MHz probe was done in every patient using standard technique in the presence of female staff. Each ultrasound findings was interpreted by one consultant radiologist (at least 3 years of experience) and was looked for adenomyosis (present/absent) as per-operational definition. All patients were then undergone magnetic resonance imaging which was performed on a 1.5-T system with

T2-weighted spin-echo or T2-weighted turbo spin-echo (TSE) sequences in sagittal, oblique axial or coronal planes, and T1-weighted spin-echo in sagittal or axial planes. Using abdomen compression, MRI sections were acquired every 5 mm with a gap of 1 mm. Each MRI findings was interpreted by one consultant radiologist (at least 5 years of experience) and was looked for adenomyosis (present/absent) as per-operational definition. Ultrasonography findings were compared with MRI findings. This all data (age, marital status (married/unmarried), menopausal status (pre-menopausal/post-menopausal), duration of symptoms, adenomyosis on transvaginal USG and MRI (present/absent) was recorded on a specially designed proforma.

**a. Inclusion Criteria:**

Female patients with suspected adenomyosis (as per-operational definition).

Patients 25-55 years of age.

Both married and unmarried.

Both pre-menopause and post-menopause.

**b. Exclusion Criteria:**

Pregnant women (assessed on USG).

Patients with uterine fibroid (assessed on ultrasonography).

Women with intrauterine contraception device (assessed on history).

Collected data was analyzed through computer software SPSS 25.0. Age and duration of symptoms were presented as mean and standard deviation. Marital status (married/unmarried), menopausal status (pre-menopausal/post-menopausal), adenomyosis on transvaginal USG and MRI (present/absent) were presented as frequency and percentage. 2x2 contingency table was used to calculate the sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of transvaginal ultrasonography in diagnosing adenomyosis, taking magnetic resonance imaging findings as gold standard.

Effect modifiers like age, marital status (married/unmarried), menopausal status (pre-menopausal/post-menopausal) and duration of symptoms were controlled through stratification. Post-stratification diagnostic accuracy was also be calculated.

## Results

Age range in this study was from 25-55 years with mean age of 40.51 – 7.47 years. Majority of the patients 67 (52.76%) were between 25 to 40 years of age. Distribution of patients according to duration of disease less than 5 months is 69.29% and more than 5 months is 30.71 %. Mean duration of disease was 4.73 – 1.53 months Distribution of patients with status of other confounding variables is shown in (Tab.1).

All the patients were subjected to transvaginal sonography and MRI. In transvaginal ultrasound positive patients, 64 were true positive and 06 were false positive. Among 57, transvaginal ultrasound negative patients, 04 were false negative whereas 53 were true negative as shown in (Tab.2). Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of transvaginal ultrasonography in diagnosing adenomyosis, taking magnetic resonance imaging findings as gold standard was 94.12%, 89.83%, 91.43%, 92.98% and 92.13% respectively.

Confounding variables		Frequency	%age
Marital status	Unmarried	29	22.83
	Married	98	77.17
Menopausal status	Pre-menopause	79	62.20
	Post-menopause	48	37.80

**Table 1:** Distribution of patients with status of other confounding variables (n=127)

	Positive result on MRI	Negative result on MRI
Positive result on USG	64 (TP)*	06 (FP)***
Negative result on USG	04 (FN)**	53 (TN)****

**Sensitivity:** 94.12%, **Specificity:** 89.83%, **Positive Predictive Value (PPV):** 91.43%, **Negative Predictive Value (NPV):** 92.98% and **Diagnostic Accuracy:** 92.13%

**Table 2:** Diagnostic accuracy of transvaginal ultrasonography in diagnosing adenomyosis, taking magnetic resonance imaging findings as gold standard.

	Positive result on MRI	Negative result on MRI	P-value
Positive result on USG	36 (TP)	02 (FP)	0.001
Negative result on USG	04 (FN)	25 (TN)	

**Sensitivity:** 90.0%, **Specificity:** 92.59%, **Positive Predictive Value (PPV):** 94.74%, **Negative Predictive Value (NPV):** 86.21% and **Diagnostic Accuracy:** 91.04%

**Table 3:** Stratification of diagnostic accuracy with respect to age 25-40 years (n=67).

	Positive result on MRI	Negative result on MRI	P-value
Positive result on USG	28 (TP)	04 (FP)	0.001
Negative result on USG	00 (FN)	28 (TN)	

**Sensitivity:** 100.0%, **Specificity:** 87.50%, **Positive Predictive Value (PPV):** 87.50%, **Negative Predictive Value (NPV):** 100.0% and **Diagnostic Accuracy:** 93.33%

**Table 4:** Stratification of diagnostic accuracy with respect to age 25-40 years (n=60).

## Discussion

Magnetic resonance imaging (MRI) and transvaginal ultrasonography (TVUS) have been used as pre-operative imaging tools for adenomyosis and have been shown to have similar diagnostic accuracy.<sup>8-9</sup> Though TVUS has the advantage of incurring less costs, it is operator-dependent.<sup>10</sup> Various ultrasonographic criteria have been utilized for the diagnosis of adenomyosis. These sonographic criteria include the presence of heterogeneous myometrial areas, findings of anechoic areas of 1 to 3 mm in diameter in the myometrium (known as myometrial cysts), and asymmetry of anterior and posterior uterine wall thickness. Other sonographic markers of adenomyosis include the presence of echogenic striations in the sub-endometrium, sub-endometrial echogenic nodules, nodular endometrial-myometrial interface and poor definition of junctional zone.<sup>12,13</sup> At present, there is no consensus regarding the most accurate imaging feature or combination of features for the ultrasound diagnosis of adenomyosis.<sup>12,13</sup> Improved imaging recognition of adenomyosis could facilitate better understanding of the natural progression of the disease and advance its clinical treatment options outside of surgery.

This study was conducted to determine the diagnostic accuracy of transvaginal ultrasonography in diagnosing

adenomyosis, taking magnetic resonance imaging findings as gold standard. In this study, sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of transvaginal ultrasonography in diagnosing adenomyosis, taking magnetic resonance imaging findings as gold standard was 94.12%, 89.83%, 91.43%, 92.98% and 92.13% respectively. In a study, prevalence of adenomyosis was found to be 58.97% and transvaginal sonography had a sensitivity of 89.13% and specificity of 90.62% in diagnosing adenomyosis.<sup>7</sup> Another study has shown the sensitivity and specificity of transvaginal ultrasonography in diagnosing adenomyosis as 91.8% & 36.8% respectively.<sup>8</sup>

Exacoustos et al<sup>14</sup> studied a series of 72 premenopausal patients who underwent 2D- and 3D-TVUS before hysterectomy for benign indications. The prevalence of adenomyosis on histology was 44% patients. For 2D-TVUS and 3D-TVUS, the overall sensitivity was 75% and 91%, respectively, and the overall specificity was 90% and 88%. The most specific (98%) ultrasound feature on 2D-TVUS for adenomyosis was the presence of myometrial cysts and the most sensitive feature (88%) was a heterogeneous myometrium. On 3D-TVUS, both the JZdiff >4 mm and JZ infiltration and distortion had high sensitivity (88%).

Andres et al<sup>15</sup> published a systematic review on the accuracy of 2D- and 3D-TVUS. Screening the literature from the past 10 years, they included 8 studies. For 2D-ultrasonography, pooled sensitivity and specificity for the diagnosis of adenomyosis for all combined imaging characteristics was 83.8% and 63.9%, respectively. The highest sensitivity (86.0%) for a single 2D-ultrasound feature was heterogeneous myometrium. For 3D-ultrasonography, pooled sensitivity and specificity for all combined imaging characteristics was 88.9% and 56.0%, respectively. The highest pooled sensitivity (86%) and specificity (56.0%) for a single feature was for poor definition of the junctional zone.

In a systematic review of papers published up to 2010, Champaneria et al<sup>16</sup> included 23 articles, involving 2312 women. The selected studies reported data on ultrasound and/or MRI, with the reference standard for a definitive diagnosis being histology of hysterectomy specimen. Both TVUS and MRI showed high levels of accuracy for the diagnosis of adeno-

myosis. The pooled sensitivity for TVUS was 72% (95% CI, 65-79%), and the specificity was 81% (95% CI, 77-85%), whereas MRI had a pooled sensitivity of 77% (95% CI, 67-85%) and a specificity of 89% (95% CI, 84-92%).

In a retrospective series of 213 consecutive patients scheduled for hysterectomy undergoing preoperative TVUS,<sup>17</sup> the prevalence of adenomyosis was 40%. The diagnosis of adenomyosis was based on the presence of one or more of the following sonographic features: a globular uterine configuration, poor definition of the junctional zone, subendometrial echogenic linear striations, myometrial anterioposterior asymmetry, myometrial cysts, and a heterogeneous myometrial echotexture. The sensitivity and specificity of TVUS for the diagnosis of adenomyosis were 87% and 60%, respectively. The presence of subendometrial linear striations had the highest diagnostic accuracy for adenomyosis.

In a prospective study on 70 consecutive patients undergoing TVUS before hysterectomy,<sup>18</sup> the prevalence of adenomyosis was 37%. Adenomyosis was defined as the presence of at least one of the following sonographic features: heterogeneous myometrial echotexture, globular-appearing uterus, asymmetrical thickness of the anteroposterior wall of the myometrium, subendometrial myometrial cysts, subendometrial echogenic linear striations, or poor definition of the endometrialemyometrial junction. The sensitivity and specificity of TVUS for the diagnosis of adenomyosis were 80.8% and 61.4%, respectively. A regularly enlarged uterus with a globular appearance, subendometrial echogenic linear striations, and myometrial cysts were the features with the highest accuracy for the diagnosis of adenomyosis. The presence of subendometrial linear striations was the most specific sonographic feature (95.5%).

In 2009, Meredith et al<sup>19</sup> reported a systematic review on the diagnostic accuracy of TVUS for adenomyosis. They included 14 studies (involving 1895 women) between 1966 and 2007. The overall prevalence of adenomyosis was 27.9% (95% CI, 25.5-30.3). The probability of adenomyosis with an abnormal TVUS was 66.2% (95% CI, 61.6-70.6). The probability of adenomyosis with a normal TVUS was 9.1% (95% CI, 7.3-11.1). Given the inclusion of very old studies, back in times where high-frequency ultrasonography and 3D-scanning were not available yet, the overall

accuracy figures cannot be considered relevant today. This is also illustrated in the review by Levgur<sup>20</sup> including papers published from 1949 to 2005, reporting a range for sensitivity for diagnosis of adenomyosis by TVUS between 50% and 87%.

## Conclusion

This study concluded that diagnostic accuracy of transvaginal ultrasonography in diagnosing adenomyosis is quite high, and has not only dramatically improved our ability of diagnosing adenomyosis but also helps the clinicians for proper management plans. So, we recommend that transvaginal ultrasound should be used routinely in all suspected cases of adenomyosis for accurate assessment and selection of proper treatment option in order to reduce the morbidity of these patients.

**Conflict of Interest:** None

## References

1. Abbott JA. Adenomyosis and Abnormal Uterine Bleeding (AUB-A)-Pathogenesis, diagnosis, and management. *Best Prac Res Clin Obstet Gynaecol.* 2017; **40**: 68-81.
2. Struble J, Reid S, Bedaiwy MA. Adenomyosis: a clinical review of a challenging gynecologic condition. *J Minim Invasive Gynecol.* 2016; **23(2)**: 164-85.
3. Vandermeulen L, Cornelis A, Kjaergaard Rasmussen C, Timmerman D, Van den Bosch T. Guiding histological assessment of uterine lesions using 3D in vitro ultrasonography and stereotaxis. *Facts Views Vis Obgyn.* 2017; **9**: 77-84.
4. Hoyos LR, Benacerraf B, Puscheck EE. Imaging in endometriosis and adenomyosis. *Clin Obstet Gynecol* 2017; **60**: 27e37.
5. Agostinho L, Cruz R, Osorio F, Alves J, Setubal

- A, Guerra A. MRI for adenomyosis: a pictorial review. *Insights Imag*. 2018; **8(6)**: 549-56.
6. Cunningham RK, Horrow MM, Smith RJ, Springer J. Adenomyosis: a sonographic diagnosis. *Radiographics*. 2018; **38(5)**: 1576-89.
  7. Gupta S, Goel G, Agrawal S, Garg P, Khanuja E. Clinical and ultrasonological features of adenomyosis and its histopathological correlation. *Int J Reprod Contracept Obstet Gynecol* 2016; **5**: 3283-9.
  8. Sam M, Raubenheimer M, Manolea F, Aguilar H, Mathew RP, Patel VH, et al. Accuracy of findings in the diagnosis of uterine adenomyosis on ultrasound. *Abdominal Radiol*. 2020; **45**: 842-50.
  9. Pistofidis G, Makrakis E, Koukoura O, et al. Distinct types of uterine adenomyosis based on laparoscopic and histopathologic criteria. *Clin Exp ObstetGynecol* 2014; **41(2)**: 113-8.
  10. Alabiso G, Alio L, Arena S, et al. Adenomyosis: What the Patient Needs. *J Minim Invasive Gynecol* 2016; **23(4)**: 476-88.
  11. Kepkep K, Tuncay YA, Gyn mer G, et al. Transvaginal sonography in the diagnosis of adenomyosis: which findings are most accurate? *Ultrasound ObstetGynecol* 2007; **30(3)**: 341-5.
  12. Hanafi M. Ultrasound diagnosis of adenomyosis, leiomyoma, or combined with histopathological correlation. *J Hum Reprod Sci* 2013; **6(3)**: 189-93.
  13. Di Donato N, Bertoldo V, Montanari G, et al. Question mark form of uterus: a simple sonographic sign associated with the presence of adenomyosis. *Ultrasound ObstetGynecol* 2015; **46(1)**: 126-7.
  14. Exacoustos C, Brienza L, Di Giovanni A, Szabolcs B, Romanini ME, Zupi E, et al. Adenomyosis: three-dimensional sonographic findings of the junctional zone and correlation with histology. *Ultrasound Obstet Gynecol* 2011; **37**: 471-9.
  15. Andres MP, Borrelli GM, Ribeiro J, Baracat EC, Abr~ ao MS, Kho RM. Transvaginal ultrasound for the diagnosis of adenomyosis: systematic review and meta-analysis. *J Minim Invasive Gynecol* 2018; **25**: 257-64.
  16. Champaneria R, Abedin P, Daniels J, Balogun M, Khan KS. Ultrasound scan and magnetic resonance imaging for the diagnosis of adenomyosis: systematic review comparing test accuracy. *Acta Obstet Gynecol Scand* 2010; **89**: 1374-84.
  17. Sun YL, Wang CB, Lee CY, Wun TH, Lin P, Lin YH, et al. Transvaginal sonographic criteria for the diagnosis of adenomyosis based on histopathologic correlation. *Taiwan J Obstet Gynecol* 2010; **49**: 40-4.
  18. Kepkep K, Tuncay YA, Goyn mer G, Tatal E. Transvaginal sonography in the diagnosis of adenomyosis: which findings are most accurate? *Ultrasound Obstet Gynecol* 2007; **30**: 341-5.
  19. Meredith SM, Sanchez-Ramos L, Kaunitz AM. Diagnostic accuracy of transvaginal sonography for the diagnosis of adenomyosis: systematic review and metaanalysis. *Am J Obstet Gynecol* 2009; **201**: 107.
  20. Levgur M. Diagnosis of adenomyosis: a review. *J Reprod Med* 2007; **52**: 177-93.