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REVIEW ARTICLE

Sonographic Features of Adenomyosis

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ABSTRACT

The association between adenomyosis, assisted reproductive technology outcomes, and pregnancy complications is well established. The purpose of this retrospective study was to assess the most common sonographic features of adenomyosis and prevalence of coexisting pathology. Systematic retrospective assessment of 828 transvaginal color Doppler ultrasound exams was performed by a single evaluator using ViewPoint reporting system. About 132 patients with abnormal uterine bleeding and sonographic signs of adenomyosis were identified. The average age was 40.6 years. The average gravidity and parity were 2.8 and 2.2 respectively. In addition to abnormal uterine bleeding observed in all 132 patients, pelvic pain and dysmenorrhea were encountered in 64 (48%) patients respectively. Eight patients (6.1%) were infertile. The uterus was anteverted in 103 (78%), and retroverted in 29 (22%) of patients. The most common sonographic findings associated with adenomyosis were heterogeneous myometrium with striation and posterior shadowing and loss of endometrial–myometrial interface observed in 111 (84%) patients. Asymmetrical myometrial thickening was detected in 106 (80.4%), and globular uterus in 100 (75.5%) patients. Seventy-six (57.5%) patients had increased myometrial vascularity on color Doppler US. Thirty-five (26%) patients had myometrial cysts (15 superficial and 20 deep). Coexisting uterine fibroids were noticed in 40 (30.3%) patients and 20 (15.5%) patients had adnexal masses. Seventeen (12.8%) patients had intra- and extraparenchymal type of pelvic congestion syndrome. Heterogeneous myometrium with striation and posterior shadowing, loss of endometrial–myometrial interface, asymmetrical myometrial thickening, and globular uterus were the most common sonographic features of adenomyosis. Presented data will aid in development of the integrated scoring system for detection and objective assessment of adenomyosis.

Keywords: Abnormal uterine bleeding, Adenomyosis, Color Doppler ultrasound, Endometrium-myometrium interface, Myometrial cyst, Three-dimensional ultrasound, Transvaginal ultrasound.

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INTRODUCTION

Adenomyosis is a common gynecologic disorder with unclear etiology, characterized by the presence of heterotopic endometrial glands and stroma in the myometrium with adjacent smooth muscle hyperplasia, defined histopathologically. Commonly, adenomyosis is reported as an incidental finding at the time of hysterectomy. With the use of high-resolution transvaginal ultrasound and increased awareness of its sonographic appearances, it is being diagnosed more often during the last decade, especially in multiparous patients in their 4th and 5th decades of life.[1] It has been noted in up to 70% of hysterectomy specimens, and 20 to 30% of the general female population, though it is significantly underdiagnosed clinically.[2-4]

The association between adenomyosis, assisted reproductive technology (ART) outcomes, and pregnancy complications is gaining more scientific evidence in recent years.[5] Implantation failure and infertility associated with adenomyosis are due to structural and functional defects of the uterine junctional zone (JZ) impairing embryo implantation. Altered uterine peristaltic activity, abnormal endometrial growth, altered decidualization, and presence of abnormal levels of intrauterine free radicals are the most commonly reported causes of infertility treatment failures in patients with adenomyosis.[5]

Accurate diagnosis and localization of adenomyosis is important, in particular when fertility conservation is warranted. Management options include medical therapy and surgery. Medical therapies target symptomatic relief and include oral contraceptive agents, progestin therapy including the levonorgestrel-releasing intrauterine system, danazol, gonadotropin-releasing hormone agonists, and aromatase inhibitors.[6-8] More uterine-sparing surgical options are investigated for the treatment of adenomyoisis.[9,10] Surgical management can be divided into uterine-sparing options, such as hysteroscopic or laparoscopic resection of focal disease, endometrial ablation, uterine artery embolization, and magnetic resonance-guided focused ultrasound, or definitive treatment via hysterectomy.[11-16]

The sensitivity and specificity of magnetic resonance imaging (MRI) in diagnosing adenomyosis range from 88 to 93% and 67 to 91% respectively.[17] The US has limitations, especially when myomas are associated with adenomyosis (estimated coexistence in 36 to 50% of cases), making MRI an ideal imaging method in that scenario.[3,18,19] The sensitivity of US to detect adenomyosis ranges from 65 to 81%, and specificity ranges from 65 to 100%.[17,19,20] A

recent meta-analysis on the accuracy of US in the diagnosis of adenomyosis demonstrated sensitivity of 82.5% (95% confidence interval, 77.5–87.9) and specificity of 84.6% (95% confidence interval, 79.8–89.8), with a positive likelihood ratio of 4.7 (3.1–7.0) and negative likelihood ratio of 0.26 (0.18–0.39), comparable to MRI.[2]

Adenomyosis is a heterogeneous entity and thus, its sonographic appearance is also variable. The variation in the degree of invasion and the heterogeneity in the reaction of surrounding myometrium account for different US features of adenomyosis. It manifests most commonly as a diffuse disease involving the entire myometrium and commonly involves the posterior uterine wall. It can also present as a localized focal entity known as nodular adenomyosis or adenomyomas.

Common sonographic features of adenomyosis are as follows:

- Heterogeneous myometrium: Lack of homogeneity within the myometrium, with evidence of architectural disturbance with increased and decreased echoes. This is most predictive of adenomyosis.[20]
- Loss of endometrial–myometrial interface: Invasion of the myometrium by the glands obscures the normally distinct endometrium–myometrium border, making it difficult to measure. The JZ is a layer that appears as a hypoechoic halo surrounding the endometrial layer. In the past, this was obtainable only with MRI; however, with high-resolution transvaginal US and three-dimensional (3D) rendering, it becomes possible to visualize and measure this layer. The JZ thickness >8 to 12 mm is reported to be associated with adenomyosis.[20]
- Echogenic linear striations: Invasion of the endometrial glands into the subendometrial tissue induces a hyperplastic reaction that appears as echogenic linear striations fanning out from the endometrial layer.
- Asymmetrical uterine wall thickening: Anteroposterior asymmetry, in particular, when the disease is focal.
- Color Doppler ultrasonography can also be used to differentiate adenomyosis from leiomyomas. Random scattering of intramural vessels is typical for adenomyosis, compared with peripheral vascularization of leiomyoma.

There is no clear terminology and consensus on classification of adenomyosis by US. The MRI classification of adenomyosis by Gordts et al[21] includes the following criteria: Evidence of JZ hyperplasia (JZ thickness ≥8 mm, but <12 mm on T2-weighted images, in women aged 35 years or less); partial or diffuse adenomyosis (thickness ≥12 mm; high-signal intensity myometrial foci; involvement of the outer myometrium: ($<^1/_3$, $<^2/_3$, $>^2/_3$), and presence of adenomyoma (myometrial mass with indistinct margins of primarily low-signal intensity on all MRI sequences). Although this classification has never been validated, debated, or submitted to a consensus meeting, many practicing radiologists use it in routine evaluation of the patients with abnormal uterine bleeding.

Since adenomyosis is a heterogeneous condition significantly affecting reproductive potential, there is a renewed interest by the scientific community and imaging professionals to study adenomyosis progression and determine the criteria for its noninvasive diagnosis, especially in the context of uterine-sparing treatment options.[21] The aim of our study was to assess the most common sonographic presentations of adenomyosis in our population. We anticipated that majority of the patients with abnormal uterine bleeding, dysmenorrhea, and pelvic pain present with two or more sonographic features. Data presented in our study will aid in development of the integrated scoring system for detection and objective assessment of adenomyosis.

MATERIALS AND METHODS

For this retrospective observational study, ethical approval was obtained from the Institutional Review Board. Systematic retrospective assessment of 828 transvaginal color Doppler and 3D US exams performed during one calendar year was performed by a single evaluator using ViewPoint 6 reporting system (GE Health care, Milwaukee, WI, USA). Postmenopausal patients and patients with diagnosis of uterine, tubal, and ovarian cancer were excluded. Abnormal uterine bleeding, pelvic pain, dysmenorrhea, infertility, enlarged uterus, and pelvic mass were the indications for pelvic US exam. Patients' symptoms were objectively assessed by their obstetrician and gynecologist who referred them to pelvic US. Sonographic features used for detection of adenomyosis were heterogeneous myometrium (presence of an indistinct myometrial area with decreased or increased echogenicity) with striation and posterior shadowing (radiate pattern of thin acoustic shadowing not arising from echogenic foci); loss of endometrial–myometrial interface; asymmetrical myometrial thickening; myometrial cyst (solitary of multiple round anechoic areas of 2 to 7 mm diameter within the myometrium), randomly increased myometrial vascularity; and globular uterus (symmetrically enlarged uterus with no evidence of focal myometrial lesions). The sequence of transvaginal US exam assessment was as follows: Visualization of the uterine longitudinal plane to identify, measure, and evaluate the endometrium borders, assess the myometrium echotexture and serosa (Fig. 1); the probe was then rotated 90° anticlockwise and the uterine cavity was visualized in the transverse plane (Fig. 2). The myometrium was systematically examined for the sonographic features associated with adenomyosis. Coexisting uterine pathology was documented. Color and pulsed Doppler were used to assess increased intramyometrial vascularity (random scattering of intramural vessels by color Doppler

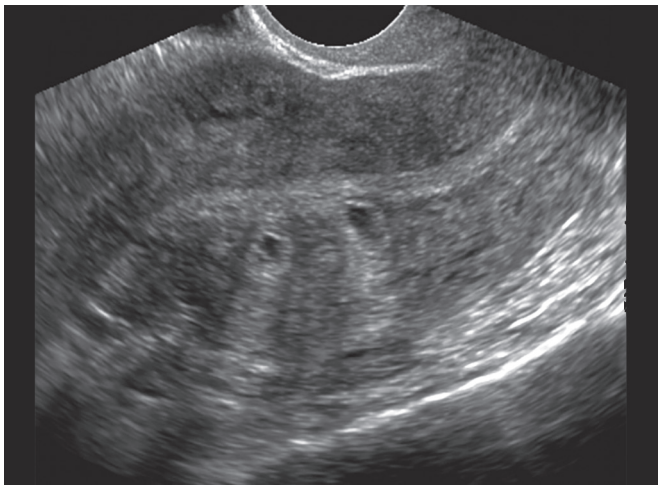

Fig. 1: Transvaginal US of the uterus in longitudinal plane. (Globular appearance of the uterus with multiple myometrial cysts in the posterior wall)

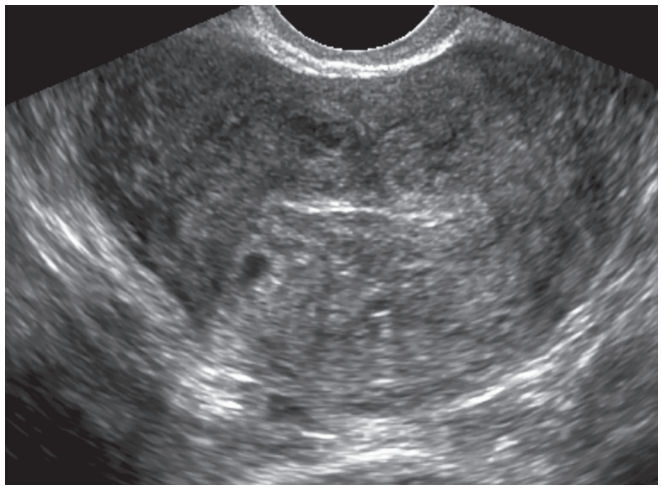

Fig. 2: Transverse plane of the same uterus. Loss of endometrial–myometrial interface, heterogeneity of the myometrium, and presence of multiple myometrial cysts

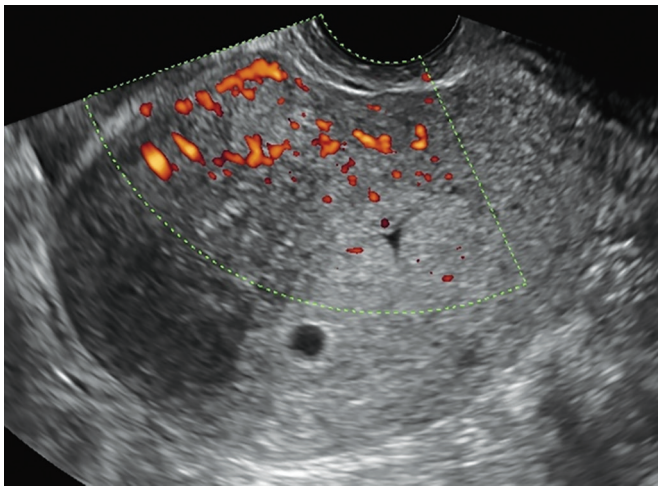

Fig. 3: Transvaginal color Doppler scan of the patient with adenomyosis. Asymmetrical anterior myometrial thickening, increased vascularity in the anterior uterine wall, loss of endometrial–myometrial interface, and solitary myometrial cyst posteriorly

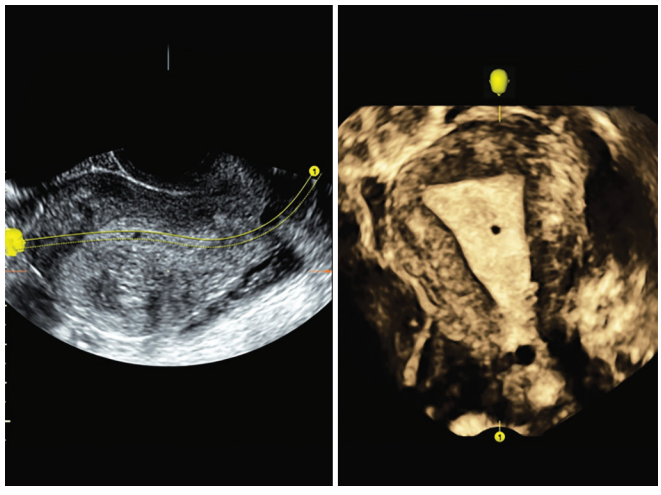

Fig. 4: The 3D US scan of a patient with adenomyosis. Coronal plane enables assessment and exact measurement of the increased JZ thickness

vascularity) and detect associated pelvic congestion syndrome (Fig. 3). Adnexal regions were assessed to detect coexisting adnexal mass (benign or malignant ovarian and/or fallopian tube lesion, including but not limited to simple and complex ovarian cysts, ovarian endometrioma, teratoma, pelvic inflammatory disease, and neoplasms).

The coronal plane obtained by 3D US was used for visualization of the echotexture, thickness, and disruption of the JZ (Fig. 4). Three high-quality US machines (Voluson S8; GE, Milwaukee, WI, USA) equipped with a transvaginal wide-band 5.0 to 9.0 MHz transducer were used, which allowed consistent approach to data collection and US examination.

Statistical Analysis

We reported mean for continuous variables, and frequency counts and percentages for nominal or categorical variables.

RESULTS

Demographic and clinical characteristics of women included in the study are summarized in Table 1. Sonographic features of adenomyosis in women included in the study are summarized in Table 2.

A total of 132 women with abnormal uterine bleeding and sonographic signs of adenomyosis were identified. The average age was 40.6 years. The average gravidity and parity were 2.8 and 2.2 respectively. In addition to abnormal uterine bleeding observed in all 132 patients, pelvic pain and dysmenorrhea were encountered in 64 (48%) patients. Eight patients (6.1%) were infertile. The uterus was anteverted in 103 (78%) patients and retroverted in 29 (22%) patients. The most common sonographic findings associated with adenomyosis were heterogeneous myometrium with striation and posterior shadowing, and loss of endometrial–myometrial interface

Table 1: Demographic and clinical characteristics of 132 patients with sonographic signs of adenomyosis

Variable	*Mean (SD)*
Age (years)	40.6
Gravidity	2.8
Parity	2.2
Symptoms	
Abnormal uterine bleeding	132 (100%)
Dysmenorrhea	64 (48%)
Pelvic pain	64 (48%)
Infertility	8 (6.1%)

SD: Standard deviation

Table 2: Sonographic features of patients with adenomyosis (N = 132)

Variable	*Frequency (%)*
Uterus anteverted	103 (78.0%)
Uterus retroverted	29 (21.9%)
Heterogeneous myometrium	111 (84.1%)
Loss of endometrial–myometrial interface	111 (84.1%)
Asymmetrical myometrial thickening	106 (80.3%)
Globular uterus	100 (75.8%)
Increased myometrial vascularity	76 (57.6%)
Myometrial cysts	35 (26.5%)
Coexisting pelvic pathology	77 (58.3%)
Fibroids	40 (30.3%)
Adnexal masses	20 (15.2%)
Pelvic congestion syndrome	17 (12.9%)

in 111 (84%) patients respectively. Asymmetrical myometrial thickening was detected in 106 (80.4%), and globular uterus in 100 (75.5%) patients. Thirty-five (26%) patients had myometrial cysts (15 superficial and 20 deep) (Figs 5 and 6). Seventy-six (57.5%) patients had increased myometrial vascularity on color Doppler US (Figs 7 and 8). Coexisting uterine fibroids were noticed in 40 (30.3%) patients, and 20 (15.5%) patients had adnexal masses. Seventeen (12.8%) patients had intra- and extraparenchymal type of pelvic congestion syndrome.

Fig. 5: Transvaginal US image of the uterus with fundal myometrial cyst

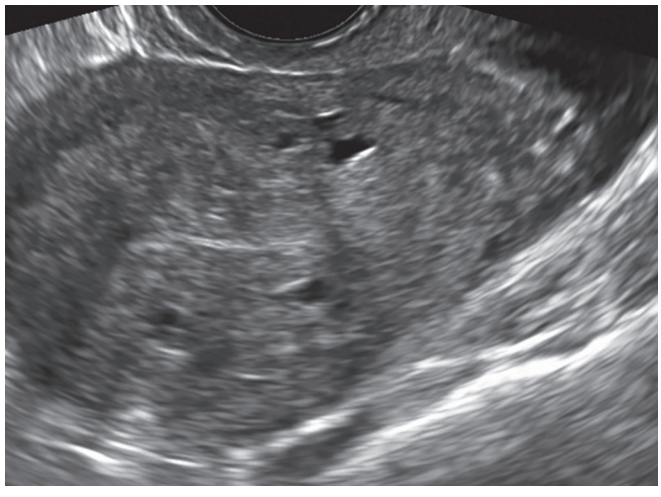

Fig. 6: Transvaginal US image of the uterus with heterogeneous myometrium, loss of endometrial–myometrial interface, and multiple myometrial cysts

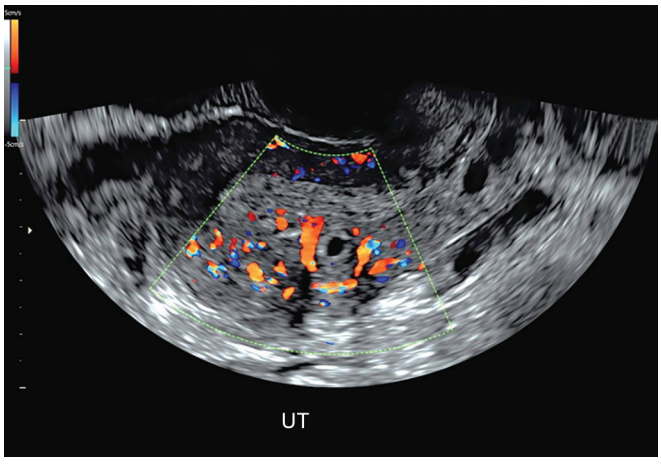

Fig. 7: Color Doppler scan illustrating increased myometrial vascularity at the periphery of the myometrial cyst

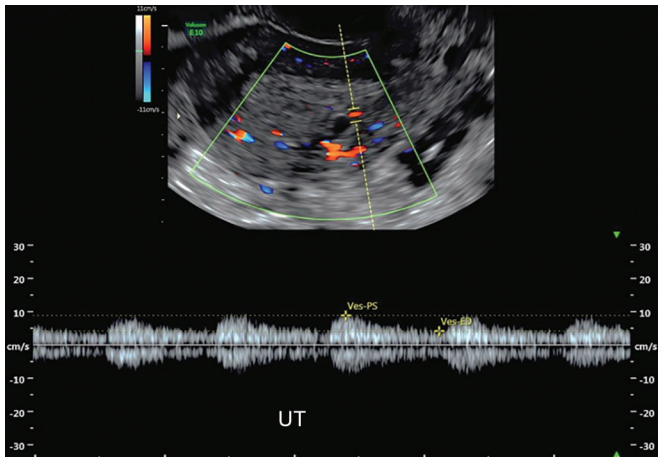

Fig. 8: Pulsed Doppler waveform analysis reveals moderate vascular impedance signals (RI 0.53) obtained from the periphery of the myometrial cyst

DISCUSSION

Our study reviews the most common sonographic features of adenomyosis. Currently, there is no consensus on the most specific imaging features of adenomyosis; neither is there consensus on classification of the disease severity based on myometrial involvement. Kepkep et al[20] reported that myometrial heterogeneity, globular uterus, myometrial cysts, and linear striations had higher statistical significance than asymmetrical myometrial thickening and loss of endometrial–myometrial interface. In our study, heterogeneous myometrium and loss of endometrial–myometrial interface were observed in 84% of patients, asymmetrical myometrial thickening in 80.4%, and globular uterus in 75.5% of patients. Coexisting pelvic pathology was observed in 58.3% of the patients in our study. Bazot et al[18] reported that 82% of patients with adenomyosis had additional pelvic pathology. The most common coexisting pathology in our study was uterine leiomyoma visualized in 40 (30.3%) patients, similarly to Kepkep et al[20] who reported that 38.5% of the adenomyosis patients had leiomyoma.

Twenty (15%) adenomyosis patients had simple ovarian cyst, and 17 (12.8%) women had pelvic congestion syndrome. Strong relationship was noticed between adenomyosis and endometriosis by other authors.[22] Interestingly, in our study, we found only five (3.8%) patients with ovarian endometrioma. In our study, eight adenomyosis patients (6.1%) were infertile, while in a recent study by Puente et al,[23] 24% of infertile patients were diagnosed with adenomyosis. In their study, the prevalence of adenomyosis was noted to be higher among women with recurrent ART failure and patients with recurrent pregnancy loss.

The awareness of the US features of adenomyosis is important while scanning patients with abnormal uterine bleeding, pelvic pain, dysmenorrhea, infertility, and adverse pregnancy outcomes. In a meta-analysis by Vercellini et al,[24] *in vitro* fertilization/intracytoplasmic sperm injection patients with adenomyosis had significantly lower clinical pregnancy rate (on average 28% lower) than control group. Coronal plane of the uterus obtained by 3D US enables precise evaluation of the JZ thickness, echotexture, and disruption. Adding these criteria to the well-established sonographic signs of adenomyosis significantly improves the accuracy of its preoperative assessment in patients who did not have prior medical and/or surgical treatment (e.g., endometrial ablation).[25]

CONCLUSION

Recognition of the typical sonographic appearances of adenomyosis helps interpreting physician to establish appropriate and timely diagnosis of adenomyosis. About 84% of our patients had multiple sonographic features of adenomyosis. Heterogeneous myometrium with striation and posterior shadowing, loss of endometrial–myometrial interface, asymmetrical myometrial thickening, and globular uterus were the most common sonographic findings of adenomyosis in our study. Early and accurate diagnosis is important for patient counseling and treatment planning. Due to its availability, low cost, and minimal invasiveness, transvaginal US with 3D facilities is the preferred modality that should be optimally utilized for identifying various sonographic features of adenomyosis, enabling detailed mapping and classification of the disease. This may assist in performing localized treatment procedures, especially for patients who wish to retain uterus for fertility purposes. Presented data will aid in development of the integrated scoring system for detection and objective assessment of adenomyosis.

REFERENCES

1. Devlieger R, D'Hooghe T, Timmerman D. Uterine adenomyosis in the infertility clinic. Hum Reprod Update 2003 Mar-Apr;9(2):139-147.
2. 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 Jul;201(1):107.e1-107.e6.
3. Azziz R. Adenomyosis: current perspectives. Obstet Gynecol Clin North Am 1989 Mar;16(1):221-235.
4. Vercellini P, Ragni G, Trespidi L, Oldani S, Panazza S, Crosignani PG. Adenomyosis: a déjà vu? Obstet Gynecol Surv 1993 Dec;48(12):789-794.
5. Campo S, Campo V, Benagiano G. Adenomyosis and infertility. Reprod Biomed Online 2012 Jan;24(1):35-46.
6. Farquhar C, Brosens I. Medical and surgical management of adenomyosis. Best Pract Res Clin Obstet Gynaecol 2006 Aug;20(4):603-616.
7. Bragheto AM, Caserta N, Bahamondes L, Petta CA. Effectiveness of the levonorgestrel-releasing intrauterine system in the treatment of adenomyosis diagnosed and monitored by magnetic resonance imaging. Contraception 2007 Sep;76(3):195-199.
8. Garcia L, Isaacson K. Adenomyosis: Review of the Literature. J Minim Invasive Gynecol 2011 Jul-Aug;18(4):428-437.
9. Dong X, Yang Z. High-intensity focused ultrasound ablation of uterine localized adenomyosis. Curr Opin Obstet Gynecol 2010 Aug;22(4):326-330.
10. Horng HC, Chen CH, Chen CY, Tsui KH, Liu WM, Wang PH, Chang WH, Huang BS, Sun HD, Chang TC, et al. Uterine-sparing surgery for adenomyosis and/or adenomyoma. Taiwan J Obstet Gynecol 2014 Mar;53(1):3-7.
11. Fukunishi H, Funaki K, Sawada K, Yamaguchi K, Maeda T, Kaji Y. Early results of magnetic resonance-guided focused ultrasound surgery of adenomyosis: analysis of 20 cases. J Minim Invasive Gynecol 2008 Sep-Oct;15(5):571-579.
12. Kim MD, Kim S, Kim NK, Lee MH, Ahn EH, Kim HJ, Cho JH, Cha SH. Long-term results of uterine artery embolization

for symptomatic adenomyosis. AJR Am J Roentgenol 2007 Jan;188(1):176-181.

13. Kitamura Y, Allison SJ, Jha RC, Spies JB, Flick PA, Ascher SM. MRI of adenomyosis: changes with uterine artery embolization. AJR Am J Roentgenol 2006 Mar;186(3):855-864.
14. Pelage JP, Jacob D, Fazel A, Namur J, Laurent A, Rymer R, Le Dref O. Midterm results of uterine artery embolization for symptomatic adenomyosis: initial experience. Radiology 2005 Mar;234(3):948-953.
15. Wang PH, Liu WM, Fuh JL, Cheng MH, Chao HT. Comparison of surgery alone and combined surgical-medical treatment in the management of symptomatic uterine adenomyoma. Fertil Steril 2009 Sep;92(3):876-885.
16. Wood C. Surgical and medical treatment of adenomyosis. Human Reprod Update 1998 Jul-Aug;4(4):323-336.
17. Bazot M, Cortez A, Darai E, Rouger J, Chopier J, Antoine JM, Uzan S. Ultrasonography compared with magnetic resonance imaging for the diagnosis of adenomyosis: correlation with histopathology. Hum Reprod. 2001 Nov;16(11):2427-2433.
18. Bazot M, Daraï E, Rouger J, Detchev R, Cortez A, Uzan S. Limitations of transvaginal sonography for the diagnosis of adenomyosis, with histopathological correlation. Ultrasound Obstet Gynecol 2002 Dec;20(6):605-611.
19. Dueholm M, Lundorf E, Hansen ES, Sørensen JS, Ledertoug S, Olesen F. Magnetic resonance imaging and transvaginal ultrasonography for the diagnosis of adenomyosis. Fertil Steril 2001 Sep;76(3):588-594.
20. Kepkep K, Tuncay YA, Göynümer G, Tutal E. Transvaginal sonography in the diagnosis of adenomyosis: which findings are most accurate? Ultrasound Obstet Gynecol 2007 Sep;30(3):341-345.
21. Gordts S, Brosens JJ, Fusi L, Benagiano G, Brosens I. Uterine adenomyosis: a need for uniform terminology and consensus classification. Reprod Biomed Online 2008 Aug;17(2):244-248.
22. Di Donato N, Seracchioli R. How to evaluate adenomyosis in patients affected by endometriosis? Minim Invasive Surg 2014;2014:507230.
23. Puente JM, Fabris A, Patel J, Patel A, Cerrillo M, Requena A, Garcia-Velasco JA. Adenomyosis in infertile women: prevalence and the role of 3D ultrasound as a marker of severity of the disease. Reprod Biol Endocrinol 2016 Sep 20;14(1):60.
24. Vercellini P, Consonni D, Dridi D, Bracco B, Frattaruolo MP, Somigliana E. Uterine adenomyosis and in vitro fertilization outcome: a systematic review and meta-analysis. Hum Reprod 2014 May;29(5):964-977.
25. Luciano DE, Exacoustos C, Albrecht L, LaMonica R, Proffer A, Zupi E, Luciano AA. Three-dimensional ultrasound in diagnosis of adenomyosis: histologic correlation with ultrasound targeted biopsies of the uterus. J Minim Invasive Gynecol 2013 Nov-Dec;20(6):803-810.