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SCIENTIFIC ARTICLE - NARRATIVE REVIEW

ULTRASOUND IN THE DIAGNOSIS OF ENDOMETRIOSIS: AN INTEGRATIVE REVIEW

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ABSTRACT

Transvaginal ultrasonography (TVUS) has established itself as an essential tool in the diagnosis of endometriosis, standing out for its high sensitivity and specificity, especially in the identification of endometriomas. Its low cost and wide availability make it the first-choice exam for the initial detection of the disease, being able to map ovarian, pelvic and deep lesions. However, it has limitations in the identification of small lesions or in areas of difficult access, in addition to depending on the experience of the operator. Given these limitations, magnetic resonance imaging emerges as a complementary exam, providing a more detailed evaluation in complex cases and in preoperative planning. TVUS, however, has advantages over MRI in the detection of small peritoneal and intestinal lesions and in the assessment of pelvic mobility. Ultrasonography allows a detailed analysis of the distribution of lesions, aiding in surgical planning and in the formation of multidisciplinary teams for more serious cases. In addition, it plays a fundamental role in the surveillance of pregnant patients, helping to differentiate decidualized endometriomas from ovarian tumors. Finally, TVUS plays an essential role in personalizing treatment and monitoring endometriosis, contributing to early diagnosis and improving patients' quality of life.

Keywords: Imaging Diagnosis, Endometriosis, Endometrioma, Review, Ultrasonography.

INTRODUCTION

Transvaginal ultrasonography (TVUS) has become established as one of the main diagnostic tools for endometriosis, particularly due to its high sensitivity and specificity in identifying endometriomas. With its affordable cost and wide availability, TVUS has been the first-line choice in various clinical protocols, being capable of mapping ovarian lesions, pelvic anatomical features, and even deeper lesions, such as those involving the uterosacral ligaments and the rectovaginal septum. However, despite its effectiveness and popularity, the use of TVUS in endometriosis is not without limitations, especially when it comes to small lesions or those located in hard-to-reach areas, such as the intestines or extraperitoneal sites.

Moreover, the interpretation of the results depends heavily on the operator's experience, which may affect the accuracy of the examination in less specialized centers.[1,2]

Although TVUS is capable of providing crucial information for the initial detection of the disease, its ability to fully characterize the extent of endometriosis—particularly in cases of deep endometriosis or when multiple anatomical compartments are involved—may be limited. In this context, the combination of ultrasonography with other imaging modalities, such as Magnetic Resonance Imaging (MRI), has been advocated, as it offers a more comprehensive and accurate view of the disease. This narrative review aims to explore the available evidence regarding the role of TVUS in the diagnosis and clinical management of endometriosis, addressing its benefits and limitations, and discussing its integration with other diagnostic tools.[2]

METHODS

This narrative review aims to evaluate the role of transvaginal ultrasonography (TVUS) in the diagnosis and clinical management of endometriosis. For the selection of studies, articles published between 2005 and 2025 in English, Portuguese, and Spanish were included, provided they discussed the application of ultrasonography in the assessment of endometriosis. The literature search was conducted in the PubMed, Scopus, Google Scholar, and LILACS databases, using keywords such as "endometriosis," "transvaginal ultrasonography," "diagnostic imaging," among other related terms. Only studies that directly addressed the use of transvaginal ultrasonography in the identification of endometriosis were considered for this review, including clinical trials, systematic reviews, and guidelines. Articles addressing alternative diagnostic methods, other gynecological conditions, or studies conducted in non-human populations were excluded.

DISCUSSION

The clinical suspicion associated with the physical examination raises the hypothesis of endometriosis, but the use of additional diagnostic tools is necessary. Pelvic and transvaginal ultrasound with bowel preparation and magnetic resonance imaging with specialized protocols are the main imaging methods for the detection and staging of endometriosis and should be performed by professionals experienced in this diagnosis.[1]

The first imaging exam to be requested based on a suggestive physical examination is the transvaginal pelvic ultrasound. It has high sensitivity and specificity in identifying endometriomas (83% and 89%, respectively). In cases of endometriosis of the uterosacral ligaments, rectovaginal septum, and vagina, the overall sensitivity and specificity are 53% and 93%, respectively.[1] If the exam is conclusive, treatment can be indicated without the need for additional imaging tests.

Diagnostic methods used in the investigation of endometriosis have been extensively studied in recent decades, especially transvaginal ultrasound (TVUS), which, when performed at specialized centers and by experienced professionals, has shown high accuracy in diagnosing the disease.[2-4] Additionally, some centers advocate the use of techniques that enhance this diagnostic capability, such as vaginal distension with gel and bowel preparation with laxatives.[5-8]

Due to the high accuracy and greater accessibility of ultrasound compared to magnetic resonance imaging, TVUS is currently considered the first-line method for diagnosing the disease, capable of mapping and characterizing lesions with high precision, including in the extraperitoneal compartment. These characteristics support the recent shift in the role of laparoscopy, which is no longer considered

the gold standard method and is usually performed only for treatment in patients previously diagnosed by specialized imaging tests.[9,10]

The role of ultrasound (USG) goes beyond diagnosis. Detailed knowledge about the distribution and characteristics of deep endometriosis (DE) lesions in patients' organs is of utmost relevance for assessing surgical risk, preoperative counseling, and team planning. This enables, for example, the organization of a multidisciplinary team including a colorectal surgeon when there is deep intestinal involvement or a urologist when there is urinary system involvement, increasing the opportunities to provide a unified and potentially curative approach, with positive effects on the quality of life of those patients indicated for surgery.[9,11,12]

This explains why detailed imaging exams are important for guiding the procedure and can even prevent some lesions hidden from laparoscopy from being overlooked, such as those located in the extraperitoneal compartment.[13]

In 2020, important societies such as the European Society for Gynaecological Endoscopy, the European Society of Human Reproduction and Embryology, and the World Endometriosis Society published recommendations on surgical techniques and highlighted the importance of imaging methods for the proper planning of these procedures in the preoperative phase of deep endometriosis.[14]

Some authors consider ultrasound superior to MRI in detecting small peritoneal and intestinal lesions, as well as vesical nodules.[4,15]

Ultrasound offers an advantage in the evaluation of pelvic organ adhesions, as it allows for the assessment of the dynamic mobility of structures upon palpation through the probe. This method is also better at identifying small intestine lesions, particularly those located near the sigmoid and the ileocecal region, where the peristaltic movements of the intestine can hinder analysis by magnetic resonance imaging.[16] The assessment of incipient lesions in the uterosacral ligaments is more difficult with MRI, as these ligaments tend to show signals similar to endometriotic tissue. On the other hand, in ultrasound, the pathological tissue has low echogenicity, contrasting with the normal tissue, which facilitates the detection of minute lesions.[5,17,18]

In contrast, MRI is better at identifying smaller ovarian lesions compared to ultrasound and distinguishing endometriomas from other adnexal lesions, such as hemorrhagic cysts or neoplasms. Magnetic resonance imaging also has the advantage of identifying and mapping deep endometriosis lesions that affect the pelvic wall and the nerve roots from the sacral plexus.[16,19]

Researchers and guidelines suggest that transvaginal ultrasound (TVUS) should be the first-line study when there is suspicion of endometriosis, as it is not only low-cost but also easily accessible and well-tolerated by patients.[10,20] Therefore, MRI could be reserved for the evaluation of more complex specific cases and for pre-surgical staging.[10]

When comparing TVUS with transrectal ultrasound, both are equivalent in diagnosing and detailing lower intestinal lesions; however, the former is superior both in detecting extraintestinal lesions and in intestinal lesions above the rectosigmoid, factors that have led to the current disuse of the latter for this purpose.[15]

The analyses conducted by Chapron et al. (2019), when studying laparoscopic findings of the anatomical distribution of deep endometriosis lesions in the abdomen, made a significant contribution to the understanding of the disease's behavior.[9]

However, the difficulties faced by surgeons and the potential surgical risks highlighted the need for the development of non-invasive methods for this purpose, such as ultrasound. During this period, the

first studies on the subject were initiated by Bazot,[21] highlighting the high accuracy of TVUS in detecting endometriosis, particularly for the intestinal The pelvic location of the disease can be described according to three compartments: anterior, middle, and posterior.and vesical foci of the disease.[22]

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CENTRAL COMPARTMENT

The typical ultrasonographic characteristic of an endometriotic cyst located within the ovary, known as an endometrioma, is a unilocular cyst with a ground-glass appearance and no vascularization on color Doppler. It may, however, appear as unilocular solid cysts or multilocular solid cysts with papillary projections, or as a multilocular cyst.[23]

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The multilocular morphology may arise from multiple endometriomas in the same ovary. There are reports that the ultrasonographic appearance of endometriomas differed between premenopausal and postmenopausal patients.[24],[25] Endometriomas in postmenopausal patients were less frequently unilocular cysts and less likely to exhibit a ground-glass echogenicity (Figure 1).[25]

Ovarian mobility can be assessed by applying pressure to the ovaries using the endocavitary probe and by simultaneously applying abdominal pressure during the bimanual examination. Immobile ovaries are considered a soft marker of pelvic endometriosis. The operator should visualize the mobility of the ovaries against the lateral pelvic wall, against the uterus medially, against the uterosacral ligaments inferiorly, and against all other pelvic organs. Bilateral ovarian fixation behind the uterus is known as "kissing ovaries."[25]

In the presence of endometriosis in the fallopian tube, a dilated tube with thick walls and incomplete septa can be observed, with dense liquid content (hematosalpingitis) in cases of endoluminal pathology or with anechoic content (hydrosalpinx) in cases of obliteration due to adhesions.[25]

ANTERIOR COMPARTMENT

The anterior compartment is composed of the urinary bladder, uterovesical septum, and ureters. On ultrasound, bladder endometriosis appears as a hypoechoic lesion with or without regular protruding contours toward the lumen, involving the serosa, muscular layer, or submucosa of the bladder. The term bladder endometriosis should be used only when there is infiltration of the bladder wall and not in cases of adhesions or superficial peritoneal implants on the bladder serosa.[25]

During the examination, using a longitudinal cut through the cervical os and moving the probe toward the lateral pelvic wall, it is possible to assess the distal part of the ureter adjacent to the vesical trigone, in order to evaluate the presence of stenosis and consequent cephalic dilation of the pelvic ureters. This finding may suggest direct invasion or compression of the ureter by endometriotic nodules, ovarian endometriomas, or adhesions.[25]

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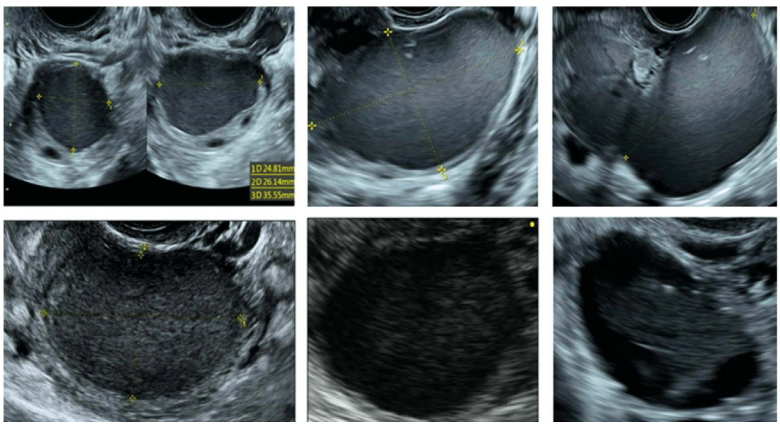

FIGURE 1. Grayscale images of typical ultrasonographic endometriomas: unilocular cysts with a ground-glass appearance inside the ovary.[25]

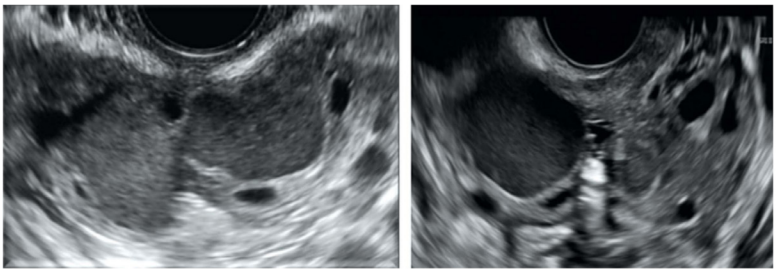

FIGURE 2. Grayscale image of kissing ovaries.[25]

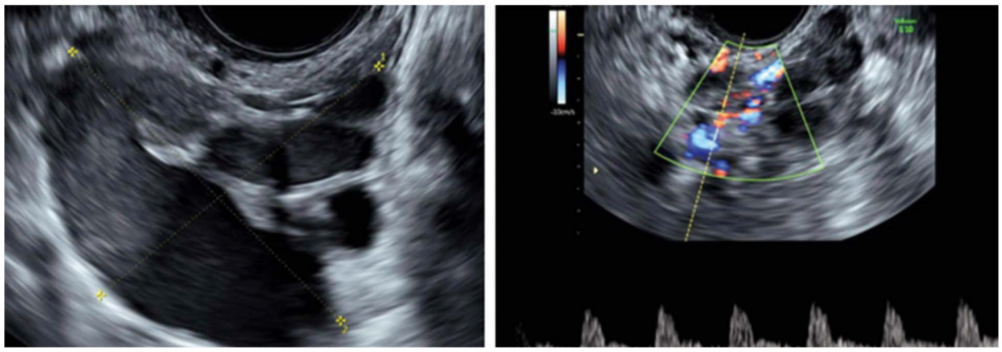

FIGURE 3. Ultrasonographic images of fallopian tube endometriosis showing a dilated tube with thick walls, incomplete septa, and dense liquid content.[25]

POSTERIOR COMPARTMENTS

The most common sites of deep infiltrative endometriosis in the posterior compartment are: posterior vaginal fornix/rectovaginal septum, uterosacral ligaments, anterior rectum/rectosigmoid junction, and sigmoid colon.[9]

The ultrasonographic characteristics of deep infiltrative endometriosis nodules were systematically defined by the International Deep Endometriosis Analysis Group. According to this classification, involvement of the rectovaginal septum should be suspected when an endometriotic nodule, appearing as a hypoechoic solid nodule with smooth or irregular contours, is seen in the rectovaginal space below the line that passes along the lower edge of the posterior cervical lip. An isolated rectovaginal septum nodule is rare and is usually an extension of the posterior vaginal wall, anterior rectal wall, or involvement of both the posterior vaginal wall and anterior rectal wall. Hourglass-shaped nodules may occur when vaginal fornix endometriosis lesions extend to the anterior rectal wall.[22,23,24]

The uterosacral ligaments affected by deep infiltrative endometriosis are characterized by the presence of hypoechoic tissue with regular/irregular margins within the peritoneal fat surrounding the uterosacral ligaments.[25]

The anterior rectum, the rectosigmoid junction, and the sigmoid colon are the areas most commonly affected in the posterior compartment. During the assessment of the posterior compartment, a negative

sliding sign (Sliding Test) between the rectosigmoid and the uterus could indicate obliteration of the Douglas pouch, while hypoechoic tissue altering the hyperechoic layer between the vagina and rectum highlights the presence of deep infiltrative endometriosis in the rectovaginal septum (Table 1).[25]

FIGURE 4. Ultrasound image showing a hypoechoic nodule on the bladder wall.[25]

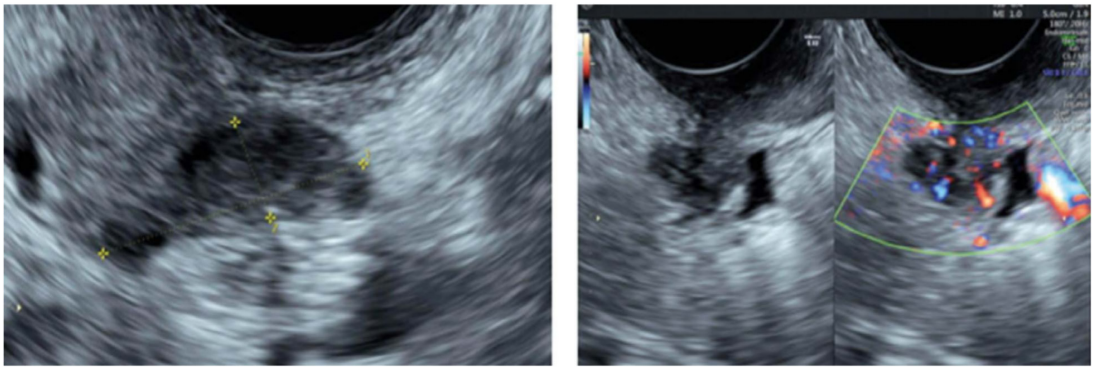

FIGURE 5. Ultrasound images of endometriotic nodules involving the uterosacral ligaments.[25]

TABLE 1. Ultrasonographic features of endometriosis.

PATHOLOGY	ULTRASONOGRAPHIC CHARACTERISTICS
Adenomyosis	• Globular shape • Enlarged dimensions of the uterus • Uterine wall asymmetry unrelate to leiomyoma • Presence of an indistinctly defined area with either descreased or increased echogenicity • Hypoechoic linear striations • Round anechoic areas of 1-7 mm diameter (myometrial cysts) • Adenomyotic lesion • Irregularities of the endometrial-myometrial junctional zone
Endometrioma	• Unilocular cyst (most commonly), multilocular, unilocular-solid, multilocular-solid (less commonly) • Ground-glass content • No vascularization on color Doppler
Deep infiltrating endometriosis	• Hypoechoic lesion with or without regular contours) • Hourglass-shaped or diabolo-like nodule appearance • Comet nodule appearance • Trickened and hyperechoic uterosacral ligaments
Decidualized endometrioma	• Unilocular-solid or multilocular-solid • Ground-glass or low-level cyst content • Rounded papillary projections with smooth surface • Well vascularized

IMPORTANCE OF ULTRASOUND IN THE TREATMENT OF ENDOMETRIOSIS

Ultrasonographic evaluation is of utmost importance in planning the timing and type of surgical procedure to be performed. Morphological representation, along with patient characteristics (age, symptoms, and desire for pregnancy), allows doctors to plan the best personalized treatment. It is known that approximately 30% to 50% of women with endometriosis become infertile. Therefore, effective evaluation of the normal residual ovarian parenchyma can allow for better preoperative counseling to avoid this outcome.[25]

In cases of deep pelvic endometriosis, the distribution of pelvic disease is becoming increasingly important. While patients with vesical endometriosis are usually symptomatic (frequency, urgency, and dysuria), women with ureteral endometriosis are often asymptomatic, leading to silent obstruction of the urinary tract and loss of renal function. In this scenario, ultrasonographic diagnosis of ureteral endometriosis with hydroureter and hydronephrosis plays a crucial role in planning the best surgical procedure.[25]

Another important issue is monitoring during pregnancy. During this period, endometriomas can undergo significant morphological changes, referred to as decidualization. This is a process in which endometrial alterations caused by high levels of progesterone increase epithelial glandular secretion, glycogen accumulation, and stromal vascularization.[25]

The most common appearance of decidualized endometriomas is a solid unilocular or multilocular ovarian mass with ground-glass content or low-level cysts, featuring rounded, well-vascularized papillary projections with a smooth surface. This appearance enables clinicians to distinguish a decidualized endometrioma from a borderline tumor, where the papillary projections typically have an irregular surface.[25]

In this context, women diagnosed with endometriomas via ultrasound before pregnancy are treated conservatively, and ultrasound monitoring is essential to understand the morphological cases. However,

the management of ovarian cysts during pregnancy remains a challenge, and ultrasound diagnosis may sometimes be inconclusive.[25]

CONCLUSION

Ultrasound plays a crucial role in the diagnosis of endometriomas, as well as in the identification and localization of pelvic endometriosis. The ability to accurately recognize and map endometriosis in the pelvis allows for personalized patient treatment. Additionally, the examination plays an essential role in the monitoring of patients with specific conditions, such as during pregnancy, leading to better management of this patient subgroup. Finally, it is of utmost importance to expand the use of imaging exams in routine consultations to increase the early diagnosis of endometriosis and, consequently, provide more appropriate treatment.

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