Review

Transrectal ultrasound – Techniques and outcomes in the management of intestinal endometriosis

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Abstract:
The widespread use of endoscopic ultrasound has facilitated the evaluation of subepithelial and surrounding lesions of the gastrointestinal tract. Deep pelvic endometriosis, with or without infiltration of the intestinal wall, is a frequent disease that can be observed in women in their fertile age. Patients of this disease may present nonspecific signs and symptoms or be completely asymptomatic. Laparoscopic surgical resection of endometriotic lesions is the treatment of choice in symptomatic patients. An accurate preoperative evaluation is indispensable for therapeutic decisions mainly in the suspicion of intestinal wall and/or urinary tract infiltration, and also in cases where we need to establish histological diagnosis or to rule out malignant disease. Diagnostic tools, including transrectal ultrasound, magnetic resonance image, transvaginal ultrasound, barium enema, and colonoscopy, play significant roles in determining the presence, depth, histology, and other relevant data about the extension of the disease. Diagnostic algorithm depends on the clinical presentation, the expertise of the medical team, and the technology available at each institution. This article reviews and discusses relevant clinical points in endometriosis, including techniques and outcomes of the study of the disease through transrectal ultrasound and fine-needle aspiration.

Keywords:
endometriosis; endoscopic ultrasonography; fine-needle aspiration

Introduction

The concept of endometriosis is based on histological confirmation of ectopic implants of glands and/or endometrial stroma sensitive to hormones but not including those located in the myometrium.[1-3]

The pathogenesis of the disease is probably multifactorial. Retrograde menstruation is the most widespread theory that explains the implants.[4] The development of endometriosis from the metaplasia of the pluripotential coelomic epithelium may also serve as an explanation.

The disease affects between 8% and 15% of women in childbearing age.[5,6] Epidemiological data are conflicting, and clinical manifestations of this illness are usually nonspecific, making the profiles of high-risk patients difficult to establish.[2,7]

Implants can be unique or may occur in various parts of the body. They are commonly found in the ovaries, fallopian tubes, pouch of Douglas, uterosacral ligaments, pelvic peritoneum, uterus, sigmoid colon, rectum, ileum, appendix, bladder, ureter, cecum, rectovaginal septum, and vagina.[8-12] The presence of endometriosis in lymph nodes and other sites are less frequent.[8,9,13-21] A lesion infiltrating 5 mm or more beyond the peritoneal epithelium is considered deep pelvic endometriosis.[22]

Intestinal endometriosis is the most common extra genital disease that affects between 3% and 37% of women with endometriosis.[8,11] Up to 95% of intestinal endometriosis is found in the rectum and sigmoid colon. In addition, it may be present in more than one intestinal segment in 39.1% of patients or be found isolated, without being present in other pelvic sites in 20.6% of cases.[8,10,12,23-26] Deep invasion of the intestinal wall is frequent, with infiltration of the muscularis propria or even of the submucosa. The mucosa is infiltrated in less than 5% of intestinal lesions.[9,22,27]

Intestinal endometriosis is difficult to diagnose and should be considered a severe disease. An adequate diagnosis of deep endometriotic lesions remains a challenge[28] and usually occurs only years after the onset of symptoms. The time elapsed from the first complaints

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until the diagnosis of endometriosis is 7.0 (range 3.5-12.1) years.[29] The lack of specific signs and symptoms can lead to errors in diagnosis and treatment.[7,30,31] Even for cases showing signs, symptoms, and/or tests suggestive of endometriosis, other intestinal diseases, such as intestinal malignant neoplasm, should be ruled out to avoid delay or wrong medical treatment.[17,18,32]

The main gynecological clinical manifestations include chronic pelvic pain, back pain, menstrual disorders, and infertility.[6,7,9,18,27,33] Among women with endometriosis, up to 60% present chronic, not necessarily cyclic, intestinal symptoms. Diarrhea, constipation, tenesmus, nausea, vomiting, fever, anorexia, weight loss, and hematochezia may be present at different intensities.[3,34] Even without parietal invasion, an endometriotic lesion adjacent to any intestinal segment may cause digestive symptoms.[25]

Gynecological pelvic exam is considered essential for evaluating the extent of pelvic lesions.[35] Through vaginal and rectal touch examination, thickening or nodularity in the pouch of Douglas, uterosacral ligaments, and/or the rectovaginal septum is the most significant data.[33,36] However, the absence of positive signs does not rule out the disease.[37,38]

In the presence of intestinal infiltration, clinical treatment is not effective, and the chronic use of systemic therapy can lead to side effects.[7,25,31,39]

For surgical treatment of symptomatic pelvic endometriosis, laparoscopic surgical resection of all identified lesions is currently the best method of choice.[25,33,40] A preoperative map is crucial for the management of the disease.[10] At the presence of lesions in intestinal or urinary organs, a gastrointestinal or urologic surgeon is respectively recommended. Different surgical approaches are available for intestinal lesions: superficial skinning, partial longitudinal resection (with linear stapler), nodulectomy (with an endorectal circular stapler or with partial surgical resection of the wall), or segmentectomy (**Figure 1**). The proper choice of surgical technique depends on the extension, position, and depth of the lesion, which must be previously well defined through imaging methods.[28,33,40-42]

Diagnostic tools, including transrectal ultrasound (TRUS) (**Figure 2**), magnetic resonance imaging (MRI) (**Figure 3**), transvaginal ultrasound (TVUS) (**Figure 4**), barium enema (**Figure 5**), and colonoscopy (**Figure 6**), play significant roles in determining a precise preoperative diagnosis of the disease.[18,40,43–50] These data are useful in avoiding unnecessary laparoscopic approaches. Moreover, they are used for preoperative prediction and discussion of surgical plan, as well as possible complications with the patient (**Table 1**).[51]

MRI is very useful in the complete evaluation of the pelvis (pelvic floor, bladder, ureter, and muscles). It is the best option for the evaluation of ovarian endometriosis and for the accurate diagnosis of deep implants in the intestinal wall or rectovaginal septum.[43,44] Due to low cost and easy access, several authors pointed out that TVUS should be the first examination for the diagnosis of various gynecological diseases, including intestinal endometriosis.[46,48,52]

Barium enema presents 88% of sensitivity in the detection of deep intestinal lesions; however, its specificity is very low (54%).[35,45]

Colonoscopy provides specific signs of endometriosis in only 50% of deep intestinal lesions, such as subephitelial lesions that promote deformation and reduction of the lumen.[53] Sometimes, the mucosa that covers the subepithelial lesion presents edema, enanthema, friability, irregularity of surface, and/or vascular patterns.[50,51]

Given the high sensitivity and specificity obtained from using different preoperative diagnostic tools, the laparoscopic approach of endometriosis should be reserved for surgical treatment of the disease.[54]

In gastrointestinal practice, TRUS is considered the test choice to assess lesions infiltrating the intestinal wall with high accuracy in the determination of depth and histology.[25,26,28,46,53,55-62] However, TRUS is not widely used in the management of intestinal endometriosis. This review aims to provide knowledge and references to endoscopic ultrasonographers for the improvement of TRUS and fine-needle aspiration (FNA) in the algorithm of the diagnosis of endometriosis.

Methods

Articles in PubMed were searched in English and in French. For relevant clinical points, gynecological and gastrointestinal reference books in English and in Portuguese were consulted. For technical review, all the references above were consulted. The literature search was conducted prior to March 1 2012, not limited to publication year.

The keywords used in the PubMed search include the following: endometriosis with transrectal ultrasonography, endoscopic ultrasonography, and endorectal ultrasonography. A total of 137 articles were identified. Majority of the reports are case series. This review focuses on the accuracy of TRUS and its comparison with other diagnostic tools for intestinal endometriosis.

Results

TRUS was considered a diagnostic method for detecting the presence of deep rectal endometriosis. Initially, we compared preoperative TRUS with the histology of the specimens obtained during open or laparoscopic surgery. **Table 2** shows the effectiveness of TRUS in predicting intestinal infiltration.[43-46,53,63-70]

In 2007, Bazot *et al*. compared TRUS with TVUS for the infiltration of the rectovaginal septum and intestinal wall in 81 patients (**Table 3**).[48] TVUS was performed without bowel preparation using a 5 to 9 MHz rigid probe,

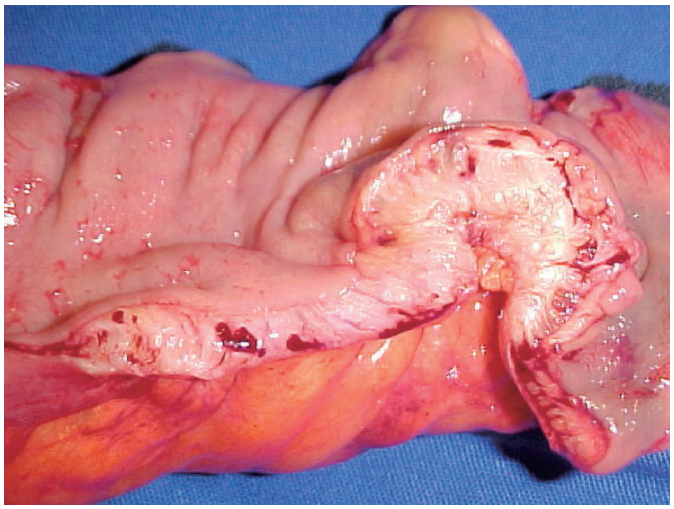

Figure 1. Macroscopic aspect of intestinal endometriosis (segmentectomy of the sigmoid).

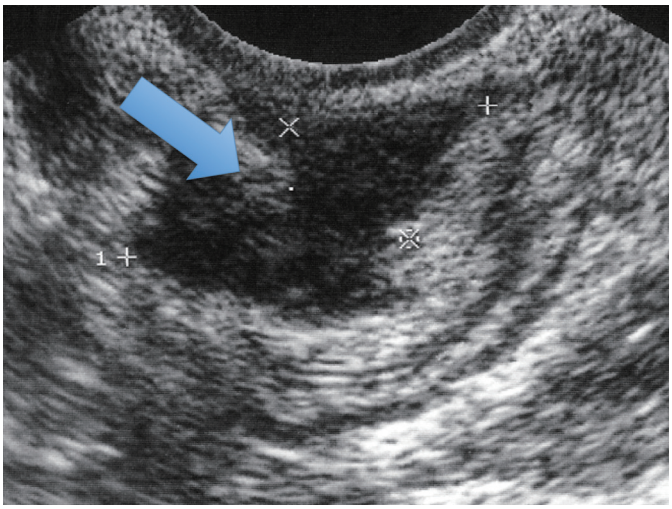

Figure 4. Endometriotic infiltrating lesion in the intestinal wall (TVUS). TVUS: transvaginal ultrasound.

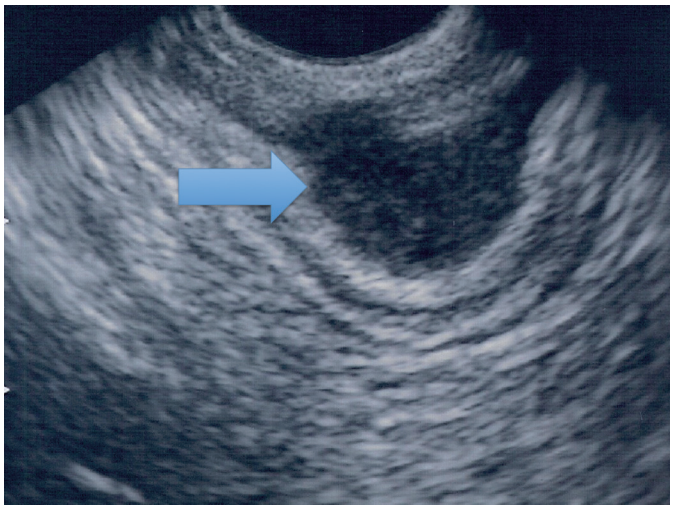

Figure 2. Endometriotic infiltrating lesion in the intestinal wall (TRUS). TRUS: transrectal ultrasound.

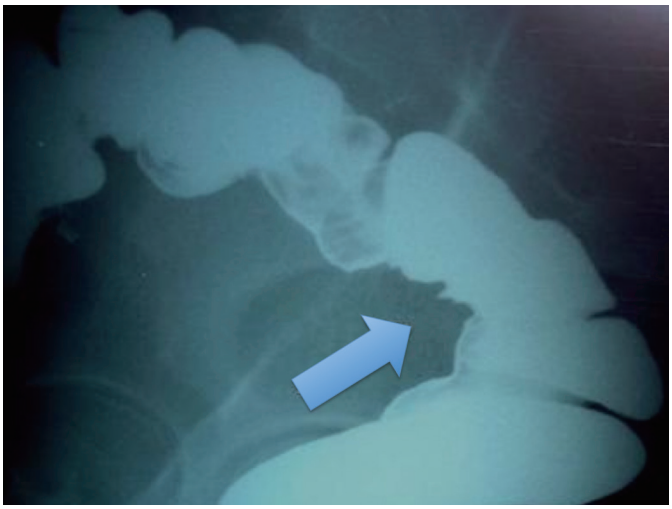

Figure 5. Endometriotic infiltrating lesion in the intestinal wall (Barium enema).

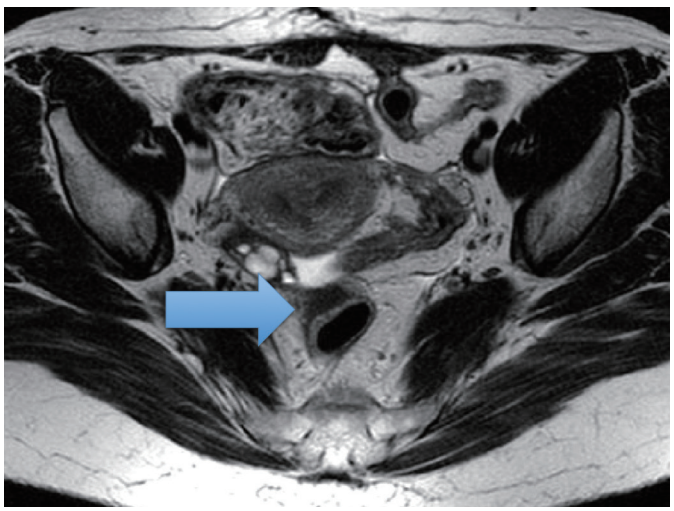

Figure 3. Endometriotic infiltrating lesion in the intestinal wall (MRI). MRI: magnetic resonance imaging.

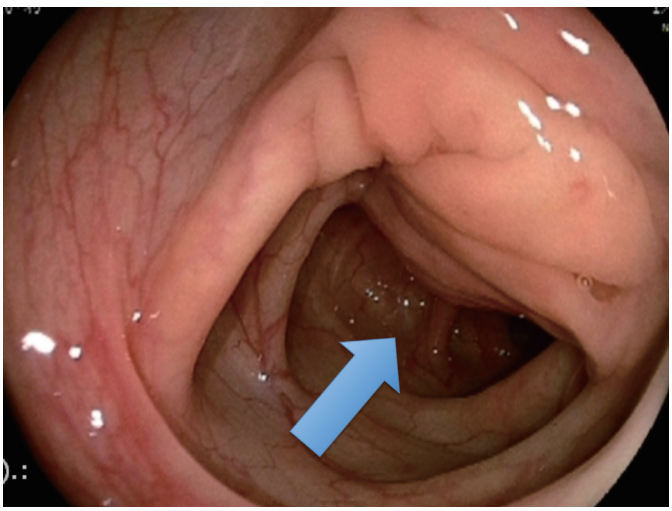

Figure 6. Endometriotic infiltrating lesion in the intestinal wall (colonoscopy).

Table 1. Main questions to be defined preoperatively for a better treatment (surgical or clinical) plan[51]

	Questions to be defined	Possible changes in the approach of the disease
01	Is there a suspicion of intestinal infiltration?	If yes, the presence of a gastrointestinal surgeon during the surgical approach is suggested.
02	Is there a suspicion of urologic organ infiltration?	If yes, the presence of a urologic surgeon during the surgical approach is suggested.
03	Where is the intestinal lesion located?	Extraperitoneal lesions are more difficult to treat and are associated with more surgical complications. Sometimes, extraperitoneal lesions cannot be observed through the laparoscopic approach. They must be treated to avoid recurrence of the disease.
04	What is the depth, longitudinal, and circular extension of the intestinal infiltration?	These data allow us to choose the best technical resection procedure.
05	What is the distance between the lesion and the peritoneal reflection and the anal sphincter? Is the rectovaginal septum infiltrated?	These data provide the surgeon a strategic approach. Resection of very low lesions increases surgical complications, such as intestinal or urinary dysfunction. Resection of these lesions must be well discussed with the patient before the surgery.
06	Are there one or more intestinal lesions?	Sometimes, small lesions could be missed in the laparoscopic approach, and they must be treated to avoid recurrence of the disease.
07	Is there another synchronic lesion that could be mimicking signs and/or symptoms of endometriosis?	Other intestinal diseases, such as Crohn, diverticulae, polyps, neoplasm, and so on, may be present. Sometimes, they are the cause of the signs or symptoms. These unknown diseases can lead to surgical complications or an incorrect treatment.
08	Is the lesion an endometriotic lesion? Do we need the histology in this case?	It is not frequent, but the histology of the lesion should be clarified to avoid any mistake.

Table 2. Studies that evaluated the use of endorectal ultrasonography for predicting rectal infiltration of deep pelvic endometriosis

Study	No. of patients	Sensitivity	Specificity	Positive predictive value	Negative predictive value
Schröder *et al*.[63]	16	100	91	83	100
Fedele *et al*.[64]	34	100	98	75	100
Doniec *et al*.[65]	65	97	97	97	97
Bazot *et al*.[66]	30	82	87.5	95	64
Abrao *et al*.[67]	32	100	67	67	100
Camagna *et al*.[43]	31	100	71	81	100
Chapron *et al*.[44]	81	97	89	87	98
Thomassin *et al*.[68]	27	89	100	100	100
Delpy *et al*.[69]	30	92	66	64	92
Bahr *et al*.[70]	37	87.5	97	87.5	97
Rossini *et al*.[53]	36	100	88.9	90	100
Ribeiro *et al*.[45]	37	96.4	100	100	90
Piketty *et al*.[46]	75	96	100	100	95.2

Data represent percentage unless otherwise indicated.

whereas TRUS was performed using a 7.5 to 12 MHz flexible echoendoscope.

Bergamini compared TRUS with TVUS through water contrast in the rectum using a 6.5 MHz curvilinear rigid probe in both examinations. The results include sensitivities of 88.2% and 96%, specificities of 80% and 80%, positive predictive values of 95.7% and 98%, and negative predictive values of 57.1% and 81.8% for TRUS and TVUS, respectively.[71]

The introduction of MRI in the evaluation of patients with endometriosis led to the comparison of this technique with TRUS. The studies that compared both

Table 3. Transvaginal ultrasonography *vs.* TRUS for the diagnosis of deep endometriosis[48]

Method	Site	Sensitivity	Specificity	PPV	NPV	Accuracy
Transvaginal	RVS	11.1	100	100	90	90.1
	Intestine	92.6	100	100	87.1	95.1
TRUS	RVS	22.2	93.1	28.6	90.5	85.2
	Intestine	88.9	92.6	96.0	80.6	90.1

RVS: retovaginal septum; TRUS: transrectal ultrasound; PPV: positive predictive value; NPV: negative predictive value. Data represent porcentage unless otherwise indicated.

Table 4. Comparison between MRI and TRUS for the diagnosis of deep endometriosis

Reference	Patients	Technique	MRI	TRUS
Dumontier.et al (2000)[72]	48/16 with intestinal EDT	1.5T MRI *vs.* flexible radial echoendoscope 7.5 to 12 MHz	Sensitivity: 75% Specificity: 100%	Sensitivity: 100% Specificity: 100%
Chapron.et al (2004)[44]	81/34 with intestinal EDT	1.5 MRI *vs* flexible radial echoendoscope 7.5 to 12 MHz	Sensitivity: 76.5% Specificity: 97.9% PPV: 96.3% NPV: 85%	Sensitivity: 97.1% Specificity: 89.4% PPV: 86.8% NPV: 97.7%

MRI: magnetic resonance imaging; TRUS: transrectal ultrasound.

Table 5. Comparison between MRI and TRUS performance for the diagnosis of deep infiltrating endometriosis in different locations[73]

Location	Sensitivity		Specificity		PPV		NPV		Accuracy	
	MRI	TRUS	MRI	TRUS	MRI	TRUS	MRI	TRUS	MRI	TRUS
USLs	84.8	45.6	88.8	44.4	98.5	87.8	40	8,5	70	45.5
Vagina	77.7	7.4	85.3	100	70	100	89.7	70.9	82.9	71.6
RV septum	44.4	22.2	98.7	94.9	80	33.3	93.9	91.5	93.2	87.5
Intestines	88.3	90	92.8	89.3	96.4	94.7	78.8	80.6	89.8	89.8
Ovary	97.1	62.9	86.8	92.5	82.9	84.6	97.9	79	90.9	80.7

RV: rectovaginal septum; PPV: positive predictive value; NPV: negative predictive value; USL: uterosacral ligaments; MRI: magnetic resonance imaging; TRUS: transrectal ultrasound; TVS: transvaginal sonography. Data represent percentage unless otherwise indicated.

methods are listed in **Table 4**.[44,72]

In 2007, Bazot compared MRI with endoscopic ultrasound (EUS) for the diagnosis of deep infiltrating endometriosis in different locations for 88 patients. MRI performed better than EUS, except for the diagnosis of intestinal endometriosis (**Table 5**).[73]

Only one article compared the performance of MRI, EUS, and TVUS for the diagnosis of deep infiltrating endometriosis of 92 patients. The results are shown in **Table 6**.[74]

In terms of technical review, few studies described in detail any special TRUS technical procedure. TRUS is mainly performed with sedation. Most studies performed TRUS using a 7.5 MHz to 12 MHz radial flexible echoendoscope without special tricks for the procedure. Few studies used rigid probes through different techniques and equipment, and only one study used miniprobes. Only one detailed description was available for linear rigid probes, and it is summarized below.[63-74]

Basic techniques with rigid probes

The patient should be positioned in the left lateral decubitus with flexion of the thighs and legs. First, a deep rectal touch examination should be performed to check for anorectal stenosis and/or nodules in the regions of the anus, rectum, rectovaginal septum, pouch of Douglas, cervix, and paracervical regions. Subsequently, the rigid probe (**Figure 7**) should be introduced through the anus and immediately pointed to the back of the patient. The probe should then be slid over the sacrum for up to approximately 7 cm to 10 cm in the rectal lumen. At this point, a balloon coupled over the probe is filled with water (at least 40 mL). The probe is then pushed up gently with short up and down movements until the distal sigmoid colon. In this position, the right and left iliac vessels (**Figure 8**) and sometimes the bifurcation of abdominal aorta can be observed (**Figure 9**). Evaluation of the intestinal wall and surrounding tissues, including pelvic organs and iliac

Table 6. Comparison among MRI, TRUS, and TVS performance for the diagnosis of deep infiltrating endometriosis in different locations[74]

Location	Sensitivity			Specificity			PPV			NPV			Accuracy		
	MRI	TRUS	TVS	MRI	TRUS	TVS	MRI	TRUS	TVS	MRI	TRUS	TVS	MRI	TRUS	TVS
USLs	84.4	48.2	78.3	88.9	44.4	66.7	98.6	88.9	95.6	38	8.5	25	84.8	47.8	77.2
Vagina	80	6.7	46.7	85.5	100	95	72.7	100	82.4	89.8	68.9	78.7	83.7	69.6	79.3
RV septum	54.5	18.2	9	98.7	95	98.7	85.7	33.3	50	94.1	89.5	88.9	93.5	85.9	88
Intestines	87.4	88.9	93.6	93.1	93.1	100	96.5	96.6	100	77.1	79.4	87.9	89.1	90.2	95.6

RV: rectovaginal septum; PPV: positive predictive value; NPV: negative predictive value; USL: uterosacral ligaments; MRI: magnetic resonance imaging; TRUS: transrectal ultrasound; TVS: transvaginal sonography. Data represent percentage unless otherwise indicated.

Table 7. Echo-logic classification of intestinal endometriosis[75]

Classification	Depth of infiltration
ueT1	Extra intestinal lesion (**Figure 13**)
ueT2	Lesion that infiltrates the intestinal serosa (**Figure 14**)
ueT3	Lesion that infiltrates the serosa and muscularis própria (**Figure 15**)
ueT4	Lesion that infiltrates from the serosa to the submucosa (**Figure 16**)
ueT5	Lesion that infiltrates from the serosa to the mucosa (**Figure 17**)

vessels, is performed using movements of introduction, traction, and rotation of the probe on its longitudinal axis (clockwise and counterclockwise), as well as by compression or decompression of the transducer against the wall.

To determine the depth of the endometriotic lesions, the presence of hypoechogenic, irregular, homogeneous or heterogeneous lesions, around or infiltrating pelvic structures or the intestinal wall are considered suspect of endometriosis (**Figure 10**). As shown in **Table 7**, only one study proposed a standard classification for the determination of the depth (**Figure 11**) and location (**Figure 12**) of intestinal parietal invasion.[75,76]

Only five studies employed FNA: four retrospectives studies with few cases and one prospective with 97 patients.[77-81] All except one used flexible EUS probes for FNA without any comment about special techniques. Rossini employed the rigid TRUS-FNA technique using a transvaginal probe, with a guide to perform FNA (**Figure 18**).[81] According to the author, TRUS-FNA must be performed only in intestinal lesions, which infiltrate, at least, the deep muscular layer (ueT3), avoiding seeding implants in the path of the needle (**Figure 19**). In addition, the author stated that prophylaxis antibiotic is not necessary because the needle does not pass beyond the thickness of the affected intestinal wall. If the lesion is adherent to a cystic ovarian lesion, FNA with cystic penetration must be avoided, and prophylaxis antibiotic is recommended. During the puncture, the lesions are hard, and a grating sensation is usually felt. The author standardized five punctures to obtain materials for histological analysis. Chiba needles (19 or 22 Gauge), measuring at least 20 cm in length, or flexible standard needles for EUS (19 or 22 Gauge) can be used with the rigid transducer. No special stains were described in any of the papers (**Figures 20–22**).

Discussion

Endometriosis is a disease affecting women's health with high prevalence between menarche and menopause.[5,8,40] Intestinal endometriosis occurs in 3% to 37% of women with endometriosis.[8] An appropriate treatment for the disease could be selected by considering essential parameters, such as staging and histological confirmation.[1,28]

Until recently, the absence of a correct preoperative diagnosis frequently leads to unnecessary surgeries.[9] Current available imaging examinations provide an accurate preoperative idea of the presence and level of lesions that infiltrate the intestinal wall and other pelvic structures. The most used methods are MRI, TVUS, colonoscopy, barium enema, and TRUS.[25,28,32,41,44]

Comparative studies showed better results by using either TURS or TVUS in the evaluation of lesions that infiltrate the intestinal wall (**Table 3**).[48,52] However, these data should be analyzed with caution because published studies evaluated only selected patients with high probability of deep endometriosis, and sonographers were not blinded about the clinical data of the patients. In addition, most studies did not compare all the different diagnostic methods in the same study. Moreover, the type of transducer and the generation of the technology used

Figure 7. Hitachi Rigid Linear Probe (EUP U 33) used in the study for intestinal endosonography.

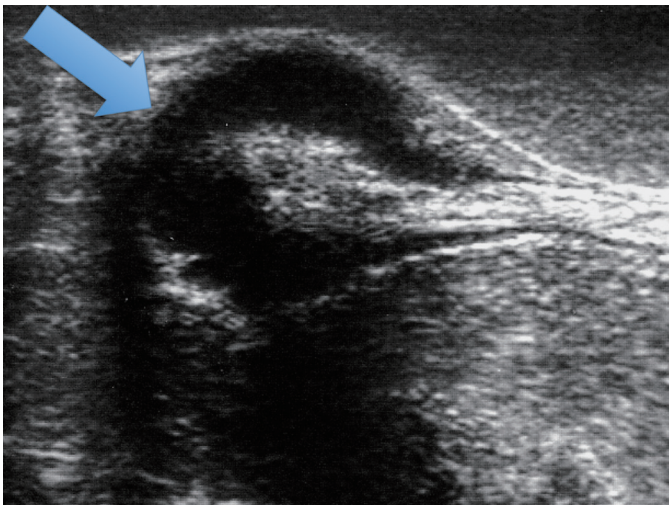

Figure 10. TRUS – hypoechogenic and heterogeneous lesions infiltrating the intestinal wall. TRUS: transrectal ultrasound.

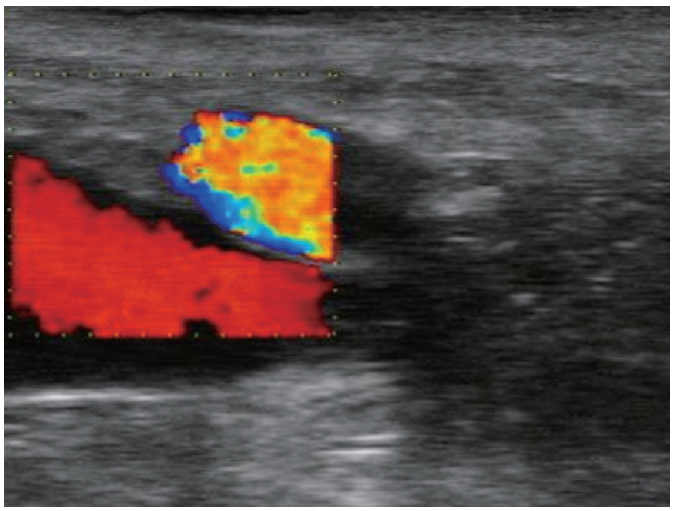

Figure 8. TRUS – right iliac vessels. TRUS: transrectal ultrasound.

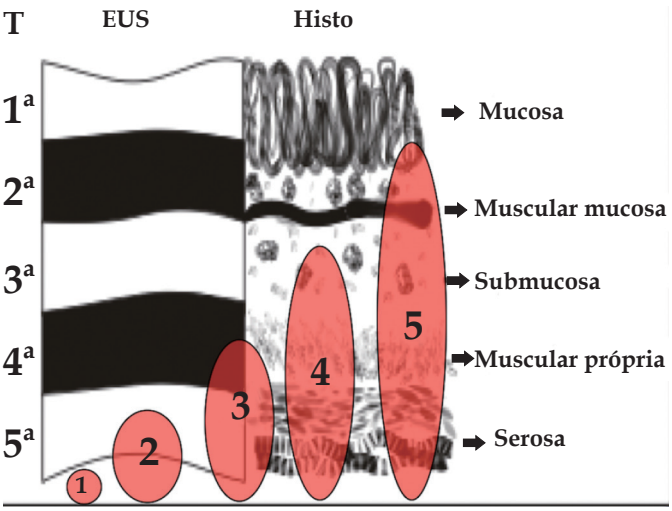

Figure 11. Echo-logic schematic classification of the depth of intestinal infiltration (ueT1-T5).[75,76]

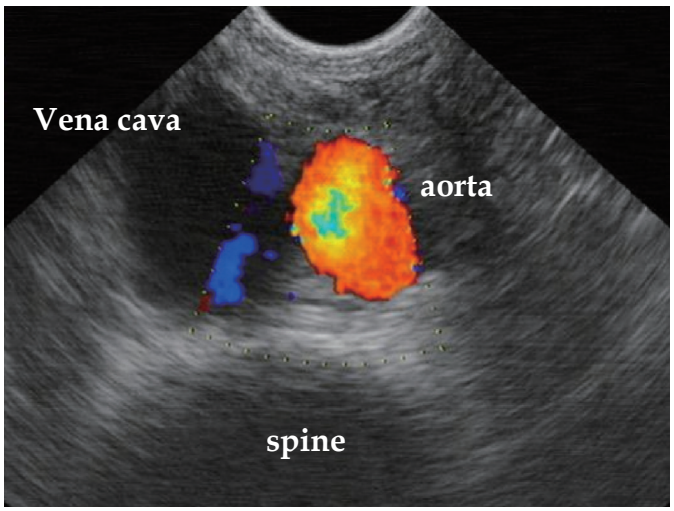

Figure 9. TRUS – vena cava, aorta, and spine (Hitachi biplane probe). TRUS: transrectal ultrasound.

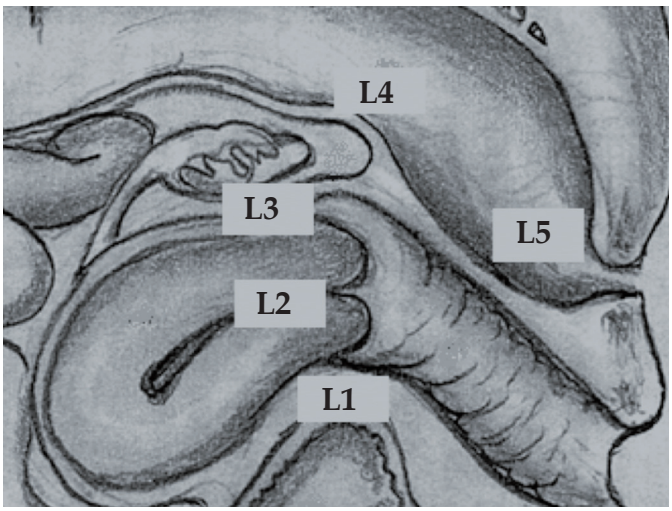

Figure 12. Echo-logic schematic classification according to pelvic site (ueL1-L5).[75,76]

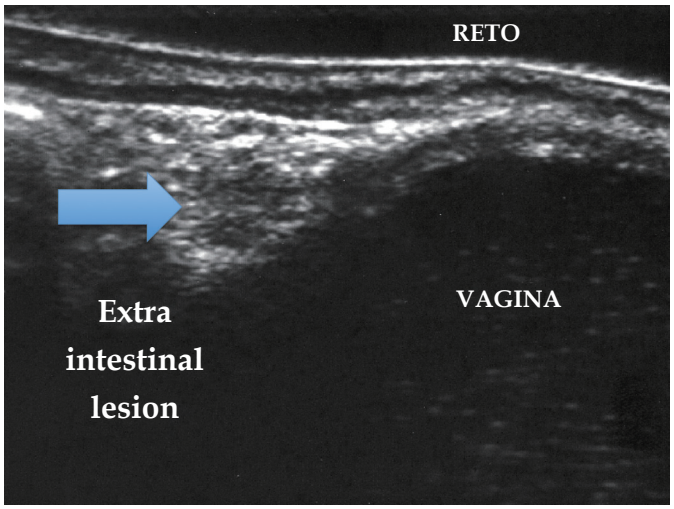

Figure 13. Endometriotic lesion ueT1 (TRUS). TRUS: transrectal ultrasound.

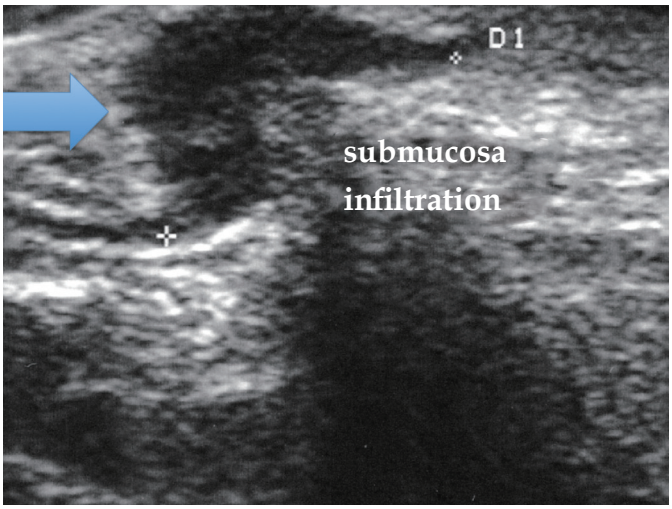

Figure 16. Endometriotic lesion ueT4 (TRUS). TRUS: transrectal ultrasound.

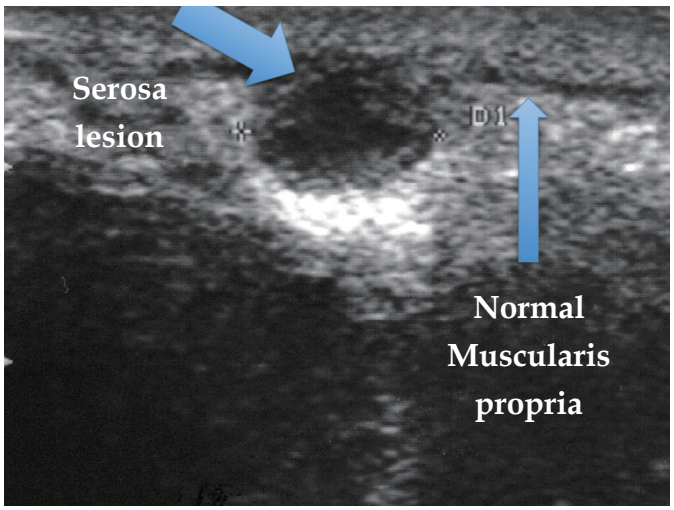

Figure 14. Endometriotic lesion ueT2 (TRUS). TRUS: transrectal ultrasound.

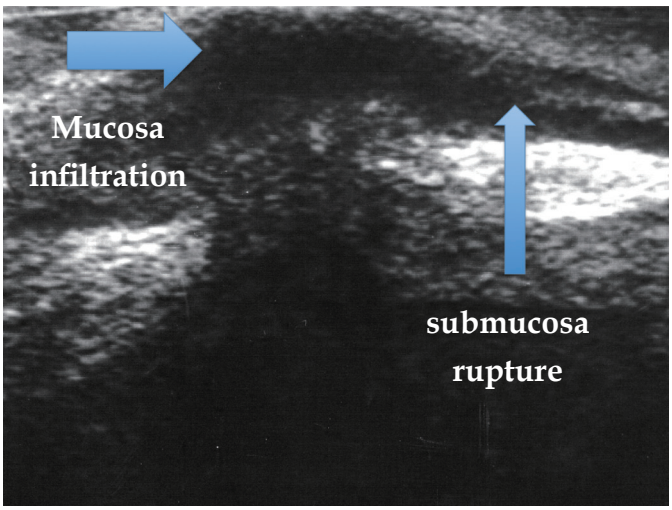

Figure 17. Endometriotic lesion ueT5 (TRUS). TRUS: transrectal ultrasound.

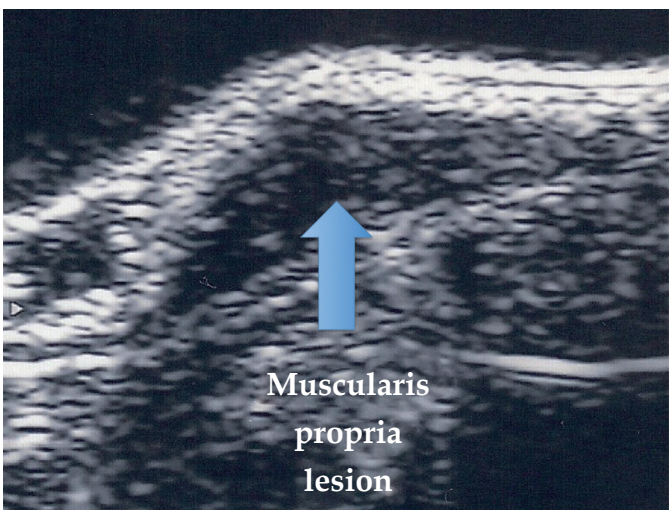

Figure 15. Endometriotic lesion ueT3 (TRUS). TRUS: transrectal ultrasound.

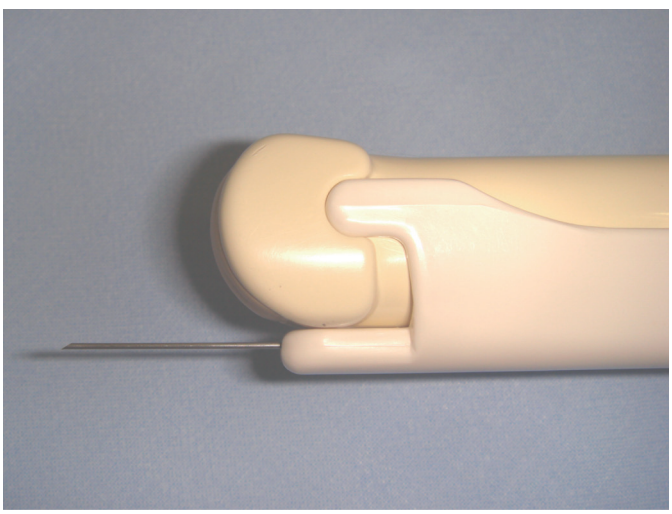

Figure 18. Rigid Probe Hitachi EUP V-33 and DCHN-22-20 needle used in the study for TRUS-FNA. FNA: fine-needle aspiration.

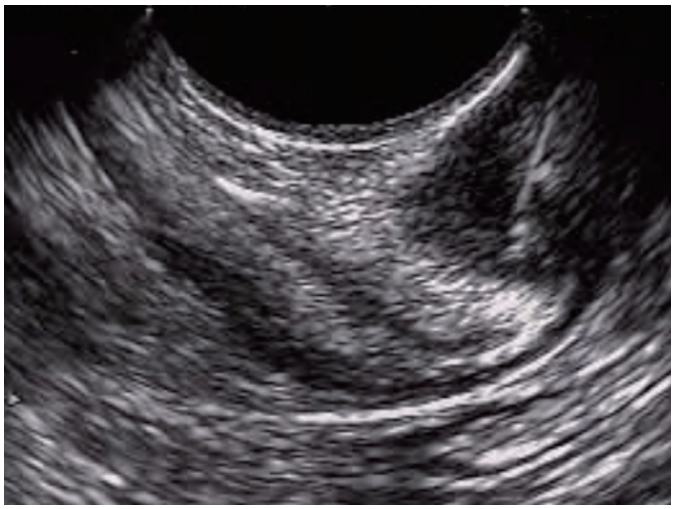

Figure 19. Intestinal endosonography showing the needle introduced within the intestinal lesion.

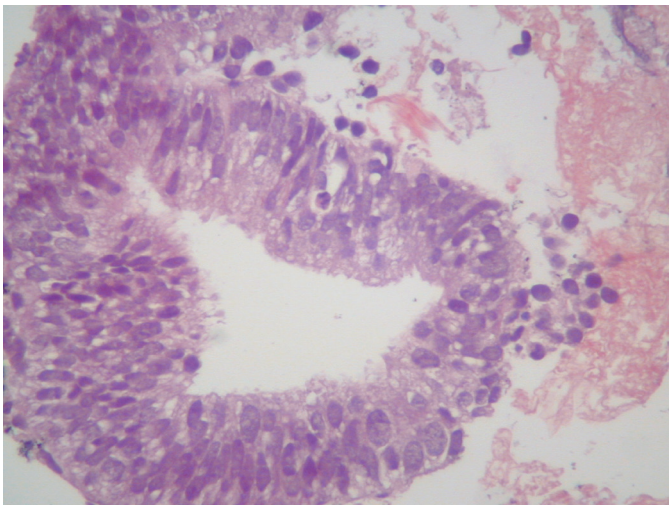

Figure 21. Histological image of the material obtained via FNA highlighting glandular pattern. FNA: fine-needle aspiration.

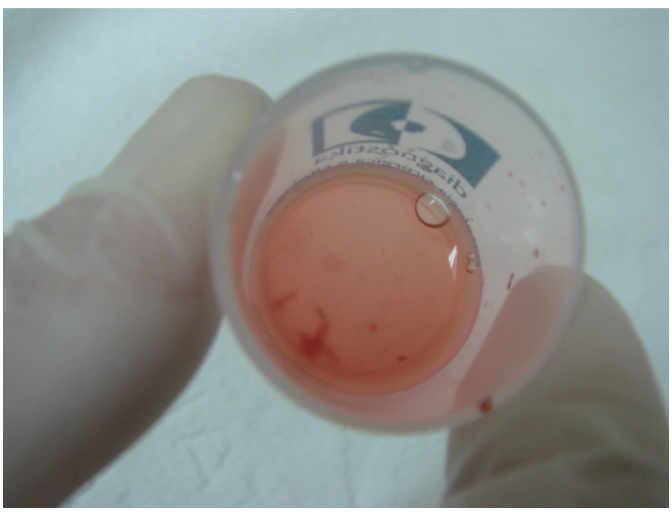

Figure 20. Material collected via FNA into the vial of 10% formaldehyde. FNA: fine-needle aspiration.

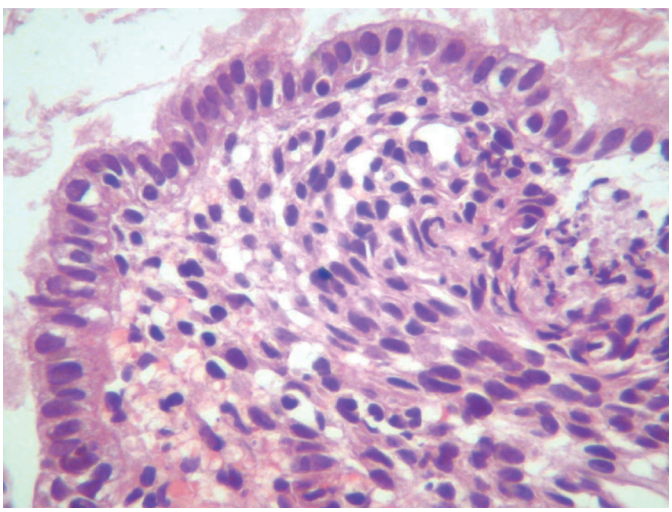

Figure 22. Histological image of the material obtained via FNA highlighting stromal pattern. FNA: fine-needle aspiration.

for TRUS and other imaging methods vary from one publication to another. The terminology used in most studies does not adopt a standard classification system concerning the depth of intestinal infiltration in layers and topographical distribution in the pelvis. Finally, the median size of the lesion is different, and percentage of the circumference of the intestinal infiltration was not mentioned in any paper.[26,54,82,83] Information and uniformity are lacked in the studies; hence, comparison of data among different diagnostic tools is difficult.

The signs and symptoms of endometriosis are non -specific and may even be absent. Therefore, during initial medical investigation, patients following different algorithms according to the main clinical manifestation have three types. Patients with predominant gastrointestinal symptoms will naturally follow gastrointestinal algorithms, those with predominant gynecological symptoms will probably follow gynecological algorithms, and those with occasional incidentalomas may follow other algorithms depending on the suspicion on the images.

MRI has lower sensitivity and specificity than TRUS and TVUS in determining the extent of infiltration on the intestinal wall and does not allow histological diagnosis (**Tables 4-6**).[43,44,84,85] MRI has the capacity to evaluate all pelvic organs and has high specificity for differentiating endometriosis from other ovarian cystic lesions. Thus, this method is usually performed in all cases of suspected deep pelvic endometriosis, allowing complete mapping of pelvic lesions. In addition, MRI may be used in re-evaluating images after the test. Hence, we suggest that MRI should be the first test in the diagnosis algorithm of deep endometriosis. For cases when MRI results show specific sites of endometriosis or are negative, more specific tests focusing on the clinical and MRI results (e.g.,

TRUS for intestinal infiltration) should be done to obtain adequate data about the lesions.

TVUS is useful in the diagnosis of uterosacral ligaments and other gynecologic structures. It may also be used in determining the level of infiltration of the rectum, distal sigmoid colon, and rectovaginal septum in patients with deep endometriosis[85-87] (**Table 6**).[74] In most cases, transvaginal transducers could be placed at an appropriate focal length from the lesion because intestinal endometriotic lesions are usually located near the posterior fornix of the vagina. However, histological diagnosis using TVUS-FNA still presents limitations, i.e., the risk of peritoneal and/or vaginal implants in the path of the needle. Standard TVUS is less expensive and more available. However, techniques for the evaluation of deep pelvic lesions are not widely used because they require special training, learning curve, and dedicated group of interest. These facts are well exposed in data from clinical practice and literatures. Before a correct diagnosis can be achieved, patients have already spent many years (time elapsed) and have undergone various TVUS.[29]

Barium enema has a low specificity in the diagnosis of infiltration of the intestinal wall and does not allow for histological diagnosis.[45,88]

Colonoscopy has a low sensitivity in providing the depth of infiltration of the intestinal wall and can only permit histological diagnosis in 5% of cases.[7,25,30,31,89,90] Nevertheless, up to 60% of patients with deep endometriosis present nonspecific chronic intestinal signs and symptoms.[2] Thus, in all these cases, colonoscopy is an essential test for ruling out the suspicion of inflammatory and malignant epithelial diseases of the colon and rectum.[2,7,9,40,50,89-94] Once symptoms indicate colonoscopy, performing colonoscopy and TRUS in the same procedure with a unique intestinal cleansing and sedation seems to be a better technical and cost effective approach than performing the two methods separately.

In gastrointestinal practice, TRUS is the standard test in determining the depth of invasion of intestinal wall lesions.[56] The results obtained in determining the presence, depth, and other data regarding endometriotic lesions of the sigmoid, rectum, and rectovaginal septum justify its clinical application.[44,53,72]

Although less frequent, inflammatory diseases, epithelial and subepithelial neoplasm, or invading extrinsic tumors of the intestinal wall can mimic the sonographic features of endometriosis. Although some of these features are nonspecific, they help differentiate the lesions.[95-97] Endometriotic lesions are greater in depth and do not infiltrate the mucosal layer. The "C" format often found in advanced stages of intestinal endometriosis due to fibrosis retraction normally does not occur in malignant diseases.[53,75] Other subepithelial benign lesions usually do not infiltrate more than one intestinal layer. Sonographic signs of serosa infiltration are strongly suggestive of malignant lesions. However, they are also present in almost all intestinal endometriotic lesions. Therefore, histological diagnosis cannot be determined only using data from imaging examinations.

TRUS is the standard technology for FNA in subepithelial and surrounding intestinal lesions.[56–58] In 2010, Rossini performed TRUS-FNA in 85 patients with suspected endometriotic lesions, characterizing the histological findings of endometriosis in 97%.[98] This number established better results than the results of Pishvaian that, in a retrospective study, evaluated five patients and obtained histological results of endometriosis in only one case.[60] However, in that study, only three patients were operated. Therefore, comparison of the results between FNA and surgical specimens is impossible. The results of the first study are also higher than those obtained generally in subepithelial lesions of the intestinal wall.[56–58] The author may have gotten better results because FNA was performed with five punctures in each lesion.

The hypothetical risk of seeding of these structures was avoided because TRUS FNA was performed without the penetration of the peritoneal cavity, and no other organs were transfixed.

In asymptomatic or oligosymptomatic patients, histological confirmation of intestinal endometriosis using TRUS-FNA, a minimally invasive procedure, rules out the diagnosis of neoplasm. Although rare, if not diagnosed early, neoplasm can bring about disastrous consequences to the patient. With a correct histological diagnosis, the asymptomatic or oligosymptomatic disease could be safely controlled through clinical and imaging examinations. The same approach is valid in symptomatic patients who do not agree with intestinal resection.

After surgical intestinal resections, staplers can lead to an inflammatory reaction and produce an infiltrative process. TRUS-FNA can be useful in post surgical intestinal resections for differentiating the inflammatory process from a recurrence of the disease in the anastomosis region, thereby helping in the therapeutic decision.

The possibility of obtaining the histological pattern (stromal, glandular, and mixed) and the degree of histological differentiation of the disease (non-differentiated, well differentiated, and mixed) before beginning the treatment should stimulate the development of more precise medical therapeutics focusing on this information.[99,100] In addition, intestinal lesion samples may be used for research on alternative treatments based on immunohistochemical or other available biological markers.

TRUS-FNA is considered a safe procedure. Therefore, special interest should be placed on this technology as a possible tool to precisely place microparticles of slow-release drugs, such as hormones and/or anti-

inflammatory agents, directly at the site of the lesion. The inoculation of small doses may have their systemic side effects reduced or eliminated. The use of stem cells could also be a potential method for conservative treatment at the lesion site of the intestinal disease through fine-needle inoculation.

Conflicts of interest

The authors disclosed no financial relationships relevant to this publication.

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