Comparison between clinical examination, transvaginal sonography and magnetic resonance imaging for the diagnosis of deep endometriosis

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BACKGROUND: Deeply infiltrating endometriosis affecting the retrocervical region and the rectosigmoid generally requires surgical treatment. Clinical examination, transvaginal ultrasonography (TVUS) and pelvic magnetic resonance imaging (MRI) are useful in the preoperative diagnosis of the involvement of these sites. The objective of this study was to evaluate the capacity of digital vaginal examination, TVUS and MRI to diagnose rectosigmoid and retrocervical involvement. METHODS: A total of 104 patients with clinically suspected endometriosis were submitted to clinical examination, pelvic MRI and TVUS until 3 months prior to videolaparoscopy and the findings of these methods were matched with histopathological confirmation of endometriosis. RESULTS: Endometriosis was histologically confirmed in 98 of 104 (94.2%) patients. With respect to the rectosigmoid and retrocervical sites, respectively, digital vaginal examination had a sensitivity of 72 and 68%, specificity of 54 and 46%, positive predictive value (PPV) of 63 and 45%, negative predictive value (NPV) of 64 and 69% and accuracy of 63 and 55%. For TVUS, sensitivity was 98 and 95%, specificity 100 and 98%, PPV 100 and 98%, NPV 98 and 97% and accuracy 99 and 97%. MRI had a sensitivity of 83 and 76%, specificity of 98 and 68%, PPV of 98 and 61%, NPV of 85 and 81% and accuracy of 90 and 71%. CONCLUSIONS: TVUS had better sensitivity, specificity, PPV, NPV and accuracy in cases of deep retrocervical and rectosigmoid endometriosis when compared with MRI and digital vaginal examination, confirming that it is an important preoperative examination for the definition of surgical strategies.

Keywords: deeply infiltrating endometriosis; diagnosis; endometriosis; transvaginal ultrasonography; magnetic resonance imaging

Introduction

Endometriosis is one of the most prevalent conditions in gynecology today and in recent years has been one of the most studied (Giudice and Kao, 2004). Following recognition of the importance of the degree of infiltration of the endometriotic lesions (Koninckx and Martin, 1992), various studies have emphasized the relevance of this topic for the adequate treatment of the disease (Brosens and Brosens, 2000). Endometriosis is considered to be infiltrative when lesions reach a depth of >5 mm into the peritoneum, and may be situated in the Douglas pouch, in the vesicouterine pouch and in other regions of the pelvis (Cornillie et al., 1990). It should be emphasized that the retrouterine, infiltrative form of the disease may be retrocervical if the primary area affected lies between the lower third of the vagina and the rectum (Martin and Batt, 2001).

Clinically, patients may complain of dysmenorrhea, deep dyspareunia, chronic pelvic pain (acyclic) and/or infertility. Depending on the site of the lesions, particularly when the bowel and the bladder are affected, patients may also experience pain during micturition and evacuation. Diagnosing endometriosis remains a dilemma in view of the non-specific nature of the symptoms, and laparoscopy continues to be the gold standard for evaluation. Although digital vaginal examination may be successful in detecting painful nodules in the posterior cul-de-sac or along the uterosacral ligaments (Cheewadhanarak et al., 2004), for many patients the physical examination may not reveal abnormalities.

Several imaging methods, such as transvaginal ultrasonography (TVUS), transrectal ultrasonography (TRUS) and magnetic resonance imaging (MRI) have been used in an attempt to improve the non-invasive diagnosis of endometriosis (Chapron et al., 1998; Fedele et al., 1998; Balleyguier et al., 2002; Abrão et al., 2004). These methods are important for establishing the site of the lesions and for assessing their dimensions, which may be useful information for determining
the choice of surgical technique to be used when surgery is indicated. (Chapron and Dubuisson, 1996).

TVUS is the most accessible imaging method for the diagnosis of pelvic endometriosis, and is the method of choice for differentiating endometriomas from other ovarian cysts (Mais et al., 1993; Guerriero et al. 1995). In recent years, some studies have emphasized the use of this method for evaluating deep endometriosis (Bazot et al., 2003; Koga et al., 2003), and have reported promising results in view of the broad availability and good tolerability of the method.

The use of MRI for the diagnosis of endometriosis underwent a major milestone following the publication of a study carried out by Nishimura et al. (1987), who demonstrated the value of this method in the diagnosis of ovarian endometriosis. Although this diagnostic tool has been shown to be effective for evaluating the ovary, TVUS remains the diagnostic method of choice in these situations, generally reserving MRI as a tool for resolving cases in which there is some doubt. The use of MRI for the evaluation of deep endometriosis was first proposed by Siegelman et al. (1994), who studied its role in analysing solid pelvic masses. However, the promising results of this method for the specific evaluation of deep endometriosis have been reported by other investigators (Kinkel et al., 1999; Bazot et al., 2004).

In view of the conflicting data in the literature with respect to the methods available for the diagnosis of deep endometriosis, the objective of this study was to compare the degree of accuracy between clinical examination, TVUS and MRI in patients with a clinical suspicion of endometriosis in the rectosigmoid and/or retrocervical regions.

**Materials and Methods**

A cross-sectional study was carried out between August 2004 and October 2006 during which time 104 consecutive patients with clinically suspected endometriosis were enrolled. All patients were submitted to clinical examination (digital vaginal examination), pelvic MRI and TVUS up to 3 months prior to surgery, followed by video-laparoscopy to obtain a definitive diagnosis (confirmed by histology) and surgical treatment of the disease. Exclusion criteria comprised: patients who were virgins or who had any type of genital malformation that made physical examination or TVUS impossible, or patients who were unable to tolerate MRI.

The decision regarding the surgical procedure to be carried out in each individual patient was based on both the clinical and imaging results. The principal symptoms related by patients were dysmenorrhea, deep dyspareunia, acyclic pelvic pain, infertility and cyclic bowel and/or urinary symptoms. The physical examination was carried out by a single examiner (M.S.A.). The digital vaginal examination was considered suggestive of deep retrocervical endometriosis when an area of thickening or a nodule was found in the uterosacral ligaments, torus uterinus and posterior vaginal fornix) and the rectovaginal septum.

The patients were suspected as having deep retrocervical endometriosis when thick blocks of tissue, nodular formations or irregular shaped, hypoechoic, retractable masses were found in this area, including lesions on the uterosacral ligament (Fig. 1), pouch of Douglas and/or vagina. Some cases present hyperechoic points. The examiner also looked for signs of adhesion to adjacent structures, and measured the longitudinal and anteroposterior diameters of the lesions.

Bowel involvement was established when a long, nodular, predominantly solid, hypoechogenic lesion adhered to the wall of the intestinal loop was detected. The degree of infiltration varied, initiating at the serosal layer but at times penetrating as far as the mucosal layer (Fig. 2). The longitudinal, anteroposterior and transversal axes of

**Figure 1:** Transvaginal sonography showing hypoechoic and irregular retrocervical endometriotic lesion (arrow) adhered to the rectum (curved arrow) C, cervix; R, rectum

**Figure 2:** Transvaginal sonography showing solid hypoechoic nodules (I, II) infiltrating the muscularis propia layer of the rectum Submucosal layer is normal (arrow)
the lesions were measured. The various layers of the wall were examined in detail, beginning at the outer layer and continuing toward the inner layers: the serosal layer (thin hyperechoic line); the two layers (internal and external) of the muscularis propria (two hypoechoic strips separated by a fine hyperechoic line); the submucosal layer (hyperechoic); the muscularis mucosa (hypoechoic) and the interface between the lumen and the mucosal layer (hyperechoic). Investigation was also carried out with respect to the presence of adherence to adjacent structures, mainly the uterus and ovaries, the presence of contained or free fluid in the pelvis, and whether there was obliteration of the Douglas pouch.

As a byproduct, information on any ovarian cysts with a thick content suspected of being endometriomas and on any deep infiltration of the bladder wall was recorded. The bladder involvement was detected by identifying hypoechoegenic, nodular formations, with or without cysts, in the vesicouterine pouch.

**Magnetic resonance imaging**

MRI examinations were performed using a 1.5T scanner (GE Signa, Milwaukee, WI, USA) with a Torso phase array coil for signal excitation and reception. Prior to undergoing MRI, the patients fasted for 4 h. An intravenous injection of a combination of hyoscine-N-butylbromide and sodium dipyramine (Buscopan®) was administered to reduce bowel movement, and around 60 ml of ultrasonographic gel was then introduced into the vaginal canal to distend the vaginal fornices. The MRI examinations were evaluated by a radiologist (R.B.), who was blinded to the patients' clinical data and to the results of the other imaging methods carried out.

Post-contrast images were obtained following administration of a manual intravenous injection of the paramagnetic contrast agent gadolinium at a dose of ~0.2 mmol/kg. No prior bowel preparation was carried out. The examinations were all considered to be of good quality and no problems occurred during their execution. The images were documented on radiographic film and in digital files (DICOM 3) and analysed at work station (AWS4 GE Milwaukee, WI, USA).

The analysis protocol included investigation of deep endometriosis in the vesicouterine pouch, retrocervical region, uterosacral ligaments, posterior vaginal fornix, rectovaginal septum and in the wall of the rectosigmoid. In addition, other findings were also registered, such as the presence of ovarian hematic cysts and adenomyosis. Retrocervical endometriosis was considered to be present when the uterosacral ligaments were found to be of irregular thickness or when retractable nodules with spiky edges were found, with a low signal.

**Figure 3:** Axial T2-weighted fast spin-echo MRI of the pelvis showing low-signal retractile lesion involving the right uterosacral ligament (curved arrow).

in T1 and T2-weighted MR images, with or without cysts (hematic or not), unilateral or bilateral, or when nodules or irregular thick blocks of tissue were found with a low signal in T1 or T2-weighted MR images, situated posterior to the cervix, near the vaginal dome (Fig. 3).

Bowel involvement was identified when retractable nodular formations were found adhered to the bowel wall, with a strong hypointense signal in T2 demonstrating delayed gadolinium enhancement (Fig. 4), leading to fixed angulation of the affected segment in the larger lesions with morphology in 'U' or in 'C'. The greater axis of the lesion was measured in the sagittal plane. In addition, evaluation was carried out on the existence of continuity of these lesions with the posterior uterine surface, causing partial or total obliteration of the posterior cul-de-sac, and whether any fluid was present. Definition of bowel involvement included identification of any lesions on the anterior wall of the rectum, on the rectosigmoid transition zone, on the sigmoid colon, cecum and intestinal loops present in the pelvic excavation.

Involvement of the vesicouterine pouch, although not a main part of the scope of this study, included the assessment of nodular formations or low-signal masses in T1 and T2, similar to the signals of the pelvic musculature, generally adhered to the anterior uterine surface and forming an obtuse angle with the bladder wall, which may or may not contain cysts. These cysts include those with an elevated signal in T1 or T1 saturation and low signal in T2 representing blood, or cavities with an elevated signal in T2 caused by the presence of non-hematic fluid. When lesions are infiltrative, they invade the bladder wall, obliterating the hypointense signal in T2 of the muscle layer, or protrude into the bladder lumen, invading the mucosa. The existence of low-signal tissue obliterating the vesicouterine pouch was considered as diffuse infiltration of the disease.

**Statistical analysis**

For each of the non-invasive diagnostic methods (TVUS, MRI and digital vaginal examination), sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy were calculated, the results of surgery being considered the gold standard. Comparisons between the parameters of these non-invasive diagnostic methods were performed using weighted least squares methods (Agresti, 2002).
Table I. Symptoms in 104 patients submitted to clinical examination, TVUS, pelvic MRI and subsequent laparoscopy for pelvic endometriosis.

<table>
<thead>
<tr>
<th>Symptom</th>
<th>n (%)</th>
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<tbody>
<tr>
<td>Dysmenorrhea</td>
<td>53 (51)</td>
</tr>
<tr>
<td>Acyclic pelvic pain</td>
<td>17 (16.3)</td>
</tr>
<tr>
<td>Deep dyspareunia</td>
<td>65 (62.5)</td>
</tr>
<tr>
<td>Cyclic bowel abnormalities (pain/bleeding)</td>
<td>61 (58.6)</td>
</tr>
<tr>
<td>Cyclic urinary abnormalities</td>
<td>14 (13.4)</td>
</tr>
<tr>
<td>Infertility</td>
<td>42 (53)</td>
</tr>
<tr>
<td>Total number of patients</td>
<td>104 (100)</td>
</tr>
</tbody>
</table>

Table II. Site of the disease in the 98 patients with endometriosis detected with laparoscopy.

<table>
<thead>
<tr>
<th>Site of the disease</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peritoneum</td>
<td>67 (68.4)</td>
</tr>
<tr>
<td>Ovary</td>
<td>42 (42.8)</td>
</tr>
<tr>
<td>Deeply infiltrating endometriosis(6)</td>
<td>54 (56.1)</td>
</tr>
<tr>
<td>Rectosigmoid</td>
<td>41 (41.9)</td>
</tr>
<tr>
<td>Retrocervical</td>
<td>19 (19.6)</td>
</tr>
<tr>
<td>Bladder</td>
<td>09 (9.2)</td>
</tr>
<tr>
<td>Total number of sites affected</td>
<td>196 (100)</td>
</tr>
</tbody>
</table>

Results

Patients were 18–45 years of age (mean 33.8 ± 6.1 years). Six patients (5.8%) were found not to have endometriosis at laparoscopy. For the 98 patients who had endometriosis detected via surgery, 196 sites were found to be affected by the disease (a mean of two sites of the disease per patient): 67 (68.4%) were found to have the peritoneal form of the disease, 42 (42.8%) had ovarian endometriosis and 63 patients (64.3%) had the deep form of the disease, 54 of these having rectosigmoid lesions, 41 with retrocervical lesions and 9 with bladder lesions. Some patients were found to have lesions at more than one site. There were three cases of endometriosis of the rectovaginal septum and the bowel was affected in all three cases. These patients were included in the group of patients with deep rectosigmoid endometriosis. The clinical data and sites of the disease, including histological confirmation of endometriosis, are shown in Tables I and II.

The parameters of accuracy of the digital vaginal examination, TVUS and MRI are compared in Table III for both the rectosigmoid and the retrocervical sites of the disease.

With respect to rectosigmoid endometriosis, there were statistically significant differences in the parameters of the three non-invasive diagnostic methods \((P < 0.0001)\) with the exception of sensitivity for which the MRI and digital vaginal examinations had similar results \((P = 0.11937)\), which differed from that obtained by TVUS \((P < 0.0001)\).

With respect to retrocervical endometriosis, there were statistically significant differences in the specificity, PPV and accuracy parameters of the three non-invasive diagnostic methods \((P < 0.0001)\); MRI and digital vaginal examination had similar sensitivities \((P = 0.4640)\), which differed from that of TVUS \((P < 0.0005)\); MRI and digital vaginal examination also had similar NPV \((P = 0.1116)\), which differed from that of TVUS \((P < 0.0001)\).

Discussion

The present study deals with the subject of deep endometriosis, a major problem in gynecology, with results indicating that a simple image method such as transvaginal ultrasound is able to improve management of this disease. Once deep endometriosis is suspected, one of the main questions related to this situation is which is the best image exam for obtaining confirmation of this hypothesis: MRI or transvaginal ultrasound? Our findings show that transvaginal ultrasound performed using a specific protocol produces very satisfactory results.

The finding that only three patients had endometriosis of the rectovaginal septum and that all of these patients had infiltration of the rectal wall allowed these cases to be included amongst the cases of rectosigmoid endometriosis. This finding is in agreement with reports in the literature suggesting that deeply infiltrating endometriosis does not originate in the rectovaginal septum (Chapron et al., 2002).

In our service, the first imaging method that was evaluated for this purpose was transrectal endoscopic ultrasound (Abrão et al., 2004), however, the widespread lack of availability of the equipment required to carry out this test, together with the inherent difficulties of transrectal examination, led us to investigate methods that would be more readily available and executable in daily clinical practice, such as TVUS and even MRI of the pelvis. Digital vaginal examination was included in this evaluation based on the observation that the physical examination is always the starting point for the entire clinical evaluation, which includes a thorough anamnesis (Table I) and an adequate physical examination. Limitations such as the patient’s pain, obesity and lesions that are inaccessible to the touch should be considered and may justify the lower accuracy of this method, as well as situations such as virginity and vaginal malformation, which motivated us to exclude patients with either of these two conditions from the study.

TVUS has classically been indicated for cases of ovarian endometriosis (Mais et al., 1993; Guerriero et al., 1995) in which cysts with even contours and thick fluid content, possibly containing fluid levels or hyperchoic foci around the edge, are suggestive of the disease. Few studies have reported the accuracy of this method in cases of deep endometriosis. Gorell et al. (1989) and Koga et al. (2003) evaluated a small number of patients and found TVUS to be a useful tool for evaluating deep endometriosis, particularly rectosigmoid endometriosis. A study carried out by Bazot et al. (2003), involving a series of 30 patients, showed high accuracy of this method in the evaluation of deep posterior endometriosis, with 77, 90, 87 and 97% of accuracy for lesions of the uterosacral ligaments, vagina, Douglas pouch and colorectal areas, respectively. In a larger series of 142 patients, this same group of investigators reported sensitivity and specificity of TVUS for these same areas as being 70.6 and 95.9%, 29.4 and 100%, 28.6 and 99.3% and 87.2 and 96.8%, respectively (Bazot et al., 2004).

In the present study, TVUS was found to have sensitivity of 98% in the case of lesions affecting the rectosigmoid and 95% for the retrocervical disease, with specificity for the two sites of 100 and 98%, respectively. These results, showing greater
Table III. Sensitivity, specificity, positive and negative predictive values and accuracy of TVUS, digital vaginal examination and MRI in the diagnosis of deep retrocervical and rectosigmoid endometriosis in the 104 patients submitted to laparoscopy.

<table>
<thead>
<tr>
<th>Site</th>
<th>Method</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recto-sigmoid</td>
<td>TVUS</td>
<td>98.1% (53/54)</td>
<td>100% (50/50)</td>
<td>100% (53/53)</td>
<td>98% (50/51)</td>
<td>99% (103/104)</td>
</tr>
<tr>
<td></td>
<td>MRI</td>
<td>83.3% (45/54)</td>
<td>98% (49/50)</td>
<td>97.8% (45/46)</td>
<td>84.4% (49/58)</td>
<td>90.3% (94/104)</td>
</tr>
<tr>
<td></td>
<td>Vaginal-digital exam</td>
<td>72.2% (39/54)</td>
<td>54% (27/50)</td>
<td>62.9% (39/62)</td>
<td>64.2% (27/42)</td>
<td>62.4% (66/104)</td>
</tr>
<tr>
<td></td>
<td>TVUS</td>
<td>95.1% (39/41)</td>
<td>98.4% (62/63)</td>
<td>98% (39/40)</td>
<td>97% (62/64)</td>
<td>97% (101/104)</td>
</tr>
<tr>
<td>Retro-cervical</td>
<td>MRI</td>
<td>76% (31/41)</td>
<td>68% (43/63)</td>
<td>61% (31/51)</td>
<td>81% (43/53)</td>
<td>71% (74/104)</td>
</tr>
<tr>
<td></td>
<td>Digital vaginal exam</td>
<td>68.3% (28/41)</td>
<td>46% (29/63)</td>
<td>45.1% (28/62)</td>
<td>69% (29/42)</td>
<td>54.8% (57/104)</td>
</tr>
</tbody>
</table>

TVUS, transvaginal ultrasonography; MRI, magnetic resonance imaging; n, number of cases; PPV, positive predictive value; NPV, negative predictive value.

The accuracy of this method in cases of rectosigmoid endometriosis and particularly for the retrocervical site when compared with the study carried out by Bazot et al. (2003), may be justified by the protocol used for carrying out TVUS, in which the patient performed prior mechanical cleansing of the lower bowel using a rectal enema one hour prior to the examination. This procedure promotes the removal of fecal content and therefore avoids the appearance of artifacts or blind areas in the image, providing the radiologist with adequate conditions in which to visualize the region, one of the sites more frequently affected by the disease. Additionally, this preparation also permits identification of the bowel layers affected by the lesions by providing an image similar to that obtained using TRUS.

With respect to MRI, some papers have shown the usefulness of this method in the diagnosis of deep endometriosis (Kinkel et al., 1999; Siegelman et al., 1994; Bazot et al., 2004; Kataoka et al., 2005; Bazot et al., 2007). In the present study sample, we found sensitivity rates of 83% for rectosigmoid endometriosis and 76% for the retrocervical disease, while specificity was 98 and 68%, respectively. Bazot et al. (2007) compared the accuracy of MRI and rectal endoscopic ultrasound and showed that both were similar with respect to colorectal endometriosis [sensitivity of 88.3 and 90% (MRI) and specificity of 92.8 and 89.3% (MRI)]; however, MRI was superior for the diagnosis of uterosacral and vaginal lesions.

We believe that the superiority of TVUS over MRI occurs, in part, because of the ease of TVUS compared with MRI in detecting small foci of the disease. Additionally, the bowel movement habitually present in this segment may generate artifacts on MRI but not with TVUS. Moreover, it is easier to follow the trajectory of the bowel using TVUS since this examination is carried out and interpreted by the examiner in real time. It is also possible to identify the presence of multiple lesions, an important point that should be emphasized. According to Chapron et al. (2003), in 39.1% of cases, bowel lesions are multifocal, while endometriosis of the bowel is isolated and unifocal in only 20.6% of cases. Another point that has to be considered when the image exam is performed relates to the distribution of deep endometriosis that it is asymmetric, more often located in the pelvis than in the abdomen and more frequently located on the left side of the pelvis (Chapron et al., 2006). This multifocality of deep endometriosis and the possible visualization that transvaginal ultrasound offers is essential for patient management, since the success of surgical treatment depends on the complete removal of all endometriotic lesions.

In the case of TVUS, the principal limiting factors, which were found in only a few patients and which did not significantly affect results, consisted of significant pain in the Douglas pouch and large myomas or ovarian cysts that did not permit the ultrasonographic field to reach the upper bowel segments. In these cases, MRI is indicated because of the panoramic view it offers of the pelvis and because it allows evaluation in multiple planes. It is also important to consider that a learning curve exists for any diagnostic method, and results will tend to continuously improve over time.

Finally, we would like to emphasize that although sensitivity and specificity are lower with the digital vaginal examination, this is a diagnostic method, i.e. fundamental for establishing the initial diagnostic suspicion of deep endometriosis. It is on the basis of this examination that suspicion of this most severe form of the disease arises, which then defines the sequence of examinations that will be requested. We would like to add that, in our study, the digital vaginal examination achieved sensitivity rates of 68 and 72% for retrocervical and rectosigmoid endometriosis, respectively. When comparing these figures with the sensitivity obtained for other methods, we should bear in mind that in our study the gynecologist was aware of the patients’ clinical data, whereas the radiologists were blinded to this information. It is possible that in a situation in which the interaction between the gynecologist and the radiologist was ideal and the radiologist was aware of the clinical status of the patients, the probability of imaging methods reaching the correct diagnosis may be even better.

The correct preoperative diagnosis is fundamental in defining the best treatment strategy for endometriosis, particularly in cases in which there is deep infiltration and bowel involvement. In this study, MRI and TVUS were effective, but their usefulness also depends on the availability and experience of the physicians carrying out the examinations. When surgery is indicated, this evaluation is critical for the definition of the multidisciplinary surgical team that will carry out the procedure and to explain to the patient the risks and benefits that the operation offers. These are issues that are important today. It is our belief that future studies will increase the resources offered by these diagnostic imaging methods in cases of deep endometriosis.
References


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