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Multislice CT enteroclysis in the diagnosis of bowel endometriosis

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Abstract This prospective study aims to evaluate the efficacy of multislice computed tomography combined with colon distension by water enteroclysis (MSCTe) in determining the presence and depth of bowel endometriotic lesions. Ninety-eight women with symptoms suggestive of colorectal endometriosis underwent MSCTe; locations, number of nodule/s, size of the nodule/s and depth of bowel wall infiltration were determined. Independently from the findings of MSCTe, all women underwent laparoscopy. MSCTe findings were compared with surgical and histological results. Abnormal findings suggestive of bowel endometriotic nodules were detected by MSCTe in 75 of the 76 patients with bowel endometriosis. MSCTe identified 110 (94.8%) of the 116 bowel endometriotic nodules removed at surgery; 6 nodules missed at MSCTe were located on the rectum. MSCTe correctly determined the degree of infiltration of the bowel wall in all of the 34 serosal bowel nodules identified at MSCTe. In six nodules reaching the submucosa, the depth of infiltration was underestimated by MSCTe. MSCTe had a sensitivity of 98.7%, a specificity of 100%, a positive predictive value of 100% and a negative predictive value of 95.7% in identifying women with bowel endometriosis. MSCTe is effective in determining the presence and depth of bowel endometriotic lesions.

Keywords Bowel endometriosis · Diagnosis · Multislice computed tomography · Water enteroclysis

Introduction

Endometriosis is a common chronic gynaecological disorder associated with pelvic pain and infertility. Its prevalence approaches 5–10% in the general female population; in women with pain, infertility or both, the frequency is 35–50%. Bowel endometriosis affects between 5 and 27% of women with endometriosis; the rectum and the rectosigmoid account for 70–93% of all intestinal endometriotic lesions [1, 2]. These lesions may cause disturbances mimicking irritable bowel syndrome and in most severe cases they can cause obstructive symptoms [2, 3].

A precise diagnosis about the presence, location and extent of rectosigmoid endometriosis is required during the preoperative workup because this information is necessary in the discussion with both the colorectal surgeon and the patient. Furthermore, almost all patients with intestinal

endometriosis have lesions in multiple pelvic locations and it is difficult to know what symptoms are caused by the intestinal disease versus the pelvic disease. In particular, in the case of sigmoid endometriosis, the lesion cannot be suspected at clinical examination, which is why sigmoid endometriosis is often diagnosed only during surgery.

Although several radiological techniques have been proposed for the diagnosis of bowel endometriosis [4], data are inconclusive and no gold standard is currently available. Double-contrast barium enema may be effective in determining the precise location of the endometriotic nodules [5], but it cannot clearly demonstrate the depth of parietal involvement. Furthermore, the experience of the radiologist in the diagnosis of bowel endometriosis remains a critical limit of this technique.

Transvaginal ultrasonography can be useful not only in the first-line exploration of the pelvic cavity, but also in diagnosing rectosigmoid endometriosis [6, 7]. However, relevant limitations of transvaginal ultrasonography consist in the impossibility of determining the exact distance of rectal lesions from the anal margin and of evaluating precisely the depth of rectal wall involvement. In addition, locations above the rectosigmoid junction might be beyond the field of view of a transvaginal approach and limited by the presence of air for a transabdominal approach. Rectal endoscopic ultrasonography has been reported to be helpful in detecting rectal wall infiltration and it may be useful in predetermining the need for intestinal resection [8–11], but no information can be obtained about the upper part of the colon and it may be difficult to fully visualize large endometriotic nodules [12]. Magnetic resonance imaging (MRI) has a high sensitivity (ranging between 77 and 93%) in the diagnosis of bowel endometriosis [11–13]. A water enema before MRI can improve the assessment of local extent of colorectal lesions [13, 14]; equally, injecting jelly for ultrasonography into the vagina and the rectum before MRI may improve the findings [15]. The effectiveness of MRI could be reduced if the exam is scheduled earlier than day 8 of the menstrual cycle because of the spontaneous T1 hyperintensity of blood after 8 days of bleeding [4]. The depth of rectal wall infiltration by endometriosis is poorly defined by MRI [14]; however, when the endorectal coil is used, MRI may distinguish mucosa, submucosa and musculature [16]. A combination of rectal endoscopic ultrasonography and MRI has recently been proposed to reduce the rate of false-negative results [12, 17].

Computed tomography (CT) is not considered the primary imaging modality for evaluation of endometriosis. Endometriotic ovarian cysts can be diagnosed by CT, but the findings are often non-specific and non-diagnostic, ranging from a predominantly solid to a predominantly cystic mass [18]. CT may be helpful in identifying unusual sites of endometriotic implants including the anterior abdominal wall, the liver and the lungs [19–22]. Although CT can occasionally demonstrate a constricting rectosigmoid mass [23], it is not routinely used for the diagnosis of bowel endometriosis and it has never been compared to MRI for the diagnosis of bowel endometriosis.

Multislice CT (MSCT) has a great potential for detecting alterations of the intestinal wall [24]. MSCT combined with enteroclysis is currently a well-defined modality for the evaluation of small bowel pathologies [25]; however, some reports describe the use of MSCT in the study of the large bowel [26–28].

MSCT allows data acquisition over the entire abdomen in thin slices, reducing peristaltic and breathing artefacts. Nowadays the quality of multiplanar reconstructions is significantly improved and they have daily clinical applications. In particular, multiplanar reconstructions are useful in investigating bowel pathology; coronal planes have the same orientation as conventional examination allowing an easier discussion with the surgeons [29].

The purpose of the current study is to investigate the efficacy of MSCT after colon distension with a water enteroclysis (MSCTe) in the diagnosis of bowel endometriosis.

Materials and methods

This prospective study was performed in the period between January 2004 and December 2005. The study was approved by the local Institutional Review Board. Before surgery, all patients were informed about experimental evaluation of MSCTe in the diagnosis of bowel endometriosis and independently from the findings of MSCTe they consented to bowel surgery if endometriotic intestinal lesions were present. All patients signed a written informed consent form.

Study population

The study included 98 women who had both typical symptoms caused by pelvic endometriosis (i.e. dyspareunia, dysmenorrhoea, chronic pelvic pain) and gastrointestinal symptoms suggestive of colorectal endometriosis.

The Rome II criteria [30] were used to classify patients' bowel habits and complaints because this classification represents a complete and extensive method of description and comparison of patients' gastrointestinal symptoms. Although these criteria are universally accepted for both research and clinical care of functional bowel disorders, they have previously been used to investigate gastrointestinal symptoms of patients with bowel endometriosis [2, 31]. Table 1 shows the Rome II Diagnostic Criteria for Irritable Bowel Syndrome; the complete system is available at the website: http://www.romecriteria.org.

Although some of the patients included in the study had previously undergone surgery for endometriosis, none of them had previous bowel surgery other than appendectomy. Demographic characteristics of the study population as

Table 1 Rome II Diagnostic Criteria for Irritable Bowel Syndrome (IBS)

Diagnostic criteria
At least 12 weeks, which need not be consecutive, in the preceding 12 months of abdominal discomfort or pain that has two of three features:
1. Relieved with defecation and/or
2. Onset associated with a change in frequency of stool and/or
3. Onset associated with a change in form (appearance) of stool
Symptoms that cumulatively support the diagnosis of IBS:
1. Abnormal stool frequency (for research purposes, 'abnormal' may be defined as more than three bowel movements per day and fewer than three bowel movements per week)
2. Abnormal stool form (lumpy/hard or loose/watery stool)
3. Abnormal stool passage (straining, urgency, or feeling of incomplete evacuation)
4. Passage of mucus
5. Bloating or feeling of abdominal distension

well as previous medical and surgical therapies were recorded.

Before surgery, all patients underwent MSCTe. The radiologists were not aware of the clinical findings and patient's history, knowing only that bowel endometriosis was suspected. None of the patients included in the study had previously undergone radiological exam of the bowel requiring contrast media. Independently from the findings of MSCTe, all women underwent laparoscopy because of the presence of ovarian or pelvic endometriosis. All patients underwent surgery within 20 days of the MSCTe.

MSCTe findings (location, number of nodule/s, size of the nodule/s, depth of wall infiltration) were compared with the surgical and histological results.

Multislice CT enteroclysis technique

Patient preparation

Patients' preparation included a low-residue diet for 3 days before the examination. On the day before the exam, each patient was asked to drink continuously 4–6 doses of a granular powder (Isocolan, Bracco, Milan, Italy; each dose contained 34.8 g PEG 4000, 1.42 g anhydrous sodium sulphate, 0.42 g sodium bicarbonate, 0.36 g sodium chloride and 0.18 g potassium chloride) dissolved in 500 ml of water per dose.

Before the water enema, to reduce bowel peristalsis and colonic spasm, 20 mg of hyoscine butylbromide (Buscopan, Boehringer Ingelheim, Florence, Italy) was administered intravenously. The patients were placed in the left lateral decubitus position on the CT table for the introduction of a rectal enema tube; colonic distension was achieved by introducing 2,000–2,300 ml of water (37°C).

All patients received an intravenous injection of iopamidol (Bracco, Milan, Italy) with an iodine concentration of 370 mg/ml; the same iodine load per patient body weight (7.4 mg/kg) was administered. The rate of intravenous injection of contrast material was set at 2.5 ml/s with an automatic power injector for all examinations. No scan was performed without iodine-containing contrast.

Bolus-tracking software designed to quantitatively and qualitatively monitor organ contrast enhancement (SmartPrep, GE Medical Systems, Waukesha, Wisconsin, USA) was used to maximize the quality of MSCT images [32, 33].

The volumetric acquisition was performed during the portal phase of the contrast medium (40 s after the arterial peak).

Scan protocol and image reconstruction

The scanning was performed in the supine position; the patients were scanned from the dome of the diaphragm to the pubic symphysis.

All patients were scanned on a 16-row MSCT scanner (LightSpeed, GE Medical Systems, Waukesha, Wisconsin, USA). The scan parameters were: 16×0.625 mm collimation, rotation time 0.7 s, tube voltage 120 kV, effective mAs 370. The estimated radiation exposure during this scan protocol was measured by the CTD index, automatically calculated by the scanner, and it was 12–14 mGy.

The MSCT image evaluation

Both the axial plane and multiplanar reconstructions (sagittal and coronal) were evaluated. Images were independently reviewed at a PACS (picture archiving and communication system) workstation by two observers; disagreement between observers was resolved by consensus in a joined session.

The MSCT criterion to diagnose bowel endometriosis was the presence of solid nodules with positive enhancement, contiguous or penetrating the thickened colonic wall.

When endometriotic lesions were located on the large bowel, different degrees of infiltration in the intestinal wall were observed. The involvement of the serosa was characterized by the presence of nodules adjacent to the bowel loop determining an irregular profile (despite pharmacologic hypotonization and forced distension with water); the fat plane between the endometriotic nodule and bowel wall often disappeared (serosal nodules). Full thickness infiltration of the muscularis was diagnosed when the endometriotic lesion reached the bowel mucosa. In some cases, pathological multilayered stratification of the bowel wall was observed with the endometriotic lesion infiltrating the submucosa which typically appears as a

hypodense layer located between the muscularis and the mucosa. The largest diameter of the endometriotic lesions was estimated.

Surgical technique

All surgical procedures were performed by a team of gynaecological and colorectal surgeons with extensive experience in the treatment of bowel endometriosis. Laparoscopy was performed introducing an umbilical and three suprapubic trocars. After adequate adhesiolysis, terminal ileum, caecum, sigmoid colon and rectum were systematically examined to verify the presence of endometriotic lesions. All visible bowel endometriotic lesions were removed.

Bowel endometriotic lesions were removed by intestinal resection according to previously published criteria [2]. Briefly, bowel resection was performed in case of: a single lesion >3 cm in diameter, a single lesion infiltrating at least 50% of the bowel wall, three or more lesions infiltrating the muscular layer; in all other cases, nodulectomy was performed.

All nodulectomies (partial or full thickness) were performed at laparoscopy with electrosurgery (either uni- or bipolar) cutting the serosa around the "tip" of the nodule leaving at least 1 cm of macroscopically normal tissue; after the first incision, the nodule was removed following the "cleavage plane".

All bowel resections were started laparoscopically and the bowel was mobilized. Bowel resection was performed either by a laparotomic Pfannenstiel incision or by exteriorizing the bowel through a small suprapubic incision (3–5 cm). Segmental resection was performed with an automatic stapler. A Knight-Griffen technique was used for low rectal lesions [34, 35]. During surgery, the anatomical distribution of bowel endometriotic lesions was recorded.

Histological evaluation of bowel specimens

Histopathologic criteria for the diagnosis of colorectal endometriosis required the presence of ectopic endometrial and stromal tissues penetrating through the bowel wall. All surgical specimens were histologically evaluated in a standardized fashion as previously described [2].

In the case of nodulectomy, the specimens were macroscopically oriented along the intestinal wall (from the serosa towards the mucosa) and cut in macrosections of 2 mm thickness. From each macrosection, tissue blocks of 1.5 cm length were obtained in variable number according to the size of the lesion. From each tissue block, a 5-mm section was obtained for microscopic evaluation.

In the case of bowel resection, the specimens were opened longitudinally through their entire length. Two-millimeter longitudinal bands of bowel wall, reaching the two resection margins and passing through all macroscopically visible lesions, were cut. These bands were sampled in tissue blocks and 5-μm sections were obtained for microscopic evaluation. These sections were stained with haematoxylin and eosin and examined histologically. All layers of bowel wall present in the sample were evaluated starting from the subserosa, and the degree of infiltration of the endometriotic lesion in the bowel wall was recorded.

Statistical analysis

Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated [36]. The Pearson correlation coefficient test was used to evaluate the correlation between the diameter of the endometriotic nodules estimated at MSCTe and that measured at the anatomopathological evaluation. Data were analysed using the SPSS software package (release 10.0.5, SPSS Inc., Chicago, IL, USA). A p value <0.05 was considered statistically significant.

Results

Demographic characteristics and symptoms of the study population are shown in Table 2.

Table 2 Characteristics of the patients (n=98) included in the study

Age (years; median, range)	34 (20–53)
Previous surgery for endometriosis (n, %)	37 (37.8)
Previous medical treatment (n, %)	
Oral contraceptive pill	81 (82.9)
GnRH analogues	40 (40.8)
Norethisterone acetate	7 (7.1)
Letrozole	2 (2.0)
Typical endometriosis-related symptoms (n, %)	
Dysmenorrhoea	87 (88.8)
Dyspareunia	73 (74.5)
Chronic pelvic pain	48 (49.0)
Infertility	23 (23.5)
Gastrointestinal symptoms[a] (n, %)	
Irritable bowel syndrome predominantly diarrhoea	20 (20.4)
Irritable bowel syndrome predominantly constipation	12 (12.2)
Functional abdominal bloating	5 (5.1)
Functional constipation	13 (13.3)
Functional diarrhoea	12 (12.2)
Unspecified functional bowel symptoms	6 (6.1)
Functional abdominal pain syndrome	27 (27.6)
Unspecified functional abdominal pain	3 (3.1)

[a]Classified according to the Rome II criteria [30]

Radiological findings

Twenty-three patients (23.5%) were found to have an entirely normal colon on MSCTe. Abnormal findings suggestive of bowel endometriotic nodules were detected in the remaining 75 patients (76.5%). Twenty-seven women had more than one endometriotic bowel nodule (2 nodules in 19 cases and 3 nodules in 8 cases); therefore, a total of 110 bowel endometriotic nodules were identified at MSCTe.

Fifty-five (50.0%) nodules were located on the sigmoid colon, 47 (42.7%) on the rectum, 5 (4.5%) on the caecum and 3 (2.7%) on the ileum (Fig. 1).

Table 3 shows the depth of infiltration in the bowel wall of the nodules identified at MSCTe.

At MSCTe the mean (±SD) larger diameter of the endometriotic nodule was estimated to be 2.5±1.2 cm (range: 0.7–5.2 cm).

Surgical findings

Bowel endometriotic lesions were observed in 76 patients; 116 endometriotic nodules were identified. Twenty-three nodules were removed by partial thickness nodulectomy, 22 were removed by full thickness nodulectomy and 71 by bowel resection. Thirty-eight women underwent bowel resection; one patient had two bowel resections because of two endometriotic nodules located on the rectum and on the caecum.

Histological findings

The endometriotic nature of all of the removed bowel lesions was confirmed at histology. In one case the proximal margin of the resected bowel specimen was infiltrated by endometriosis. The mean (±SD) larger diameter of the endometriotic nodule was 2.5±1.1 cm (range: 0.8–5.1 cm). The mean (±SD) length of the resected colorectal segment was 9.6±4.2 cm (range: 4.6–22.5 cm).

Table 3 shows the depth of infiltration in the bowel wall of the nodules identified at histology.

Comparison of radiological, surgical and histological findings

At laparoscopy, the absence of bowel endometriosis was confirmed in 22 of 23 women with entirely normal colon on MSCTe. In one patient with complete obliteration of the pouch of Douglas caused by a rectovaginal nodule, MSCTe did not identify rectal involvement (1.4 cm) infiltrating the muscular layer. Among subjects with a diagnosis of bowel endometriosis at MSCTe, an additional five nodules were identified at surgery; they were all located on the rectum and reached the serosa in three cases and the muscularis in the other two cases. Therefore, MSCTe identified 94.8% (110/116) of the bowel endometriotic nodules observed at surgery. Table 4 shows that MSCTe identified all nodules located on the sigmoid colon, caecum and ileum; 47 of 53 (88.7%) rectal nodules were diagnosed.

The histological examination of the specimens removed at surgery demonstrated that MSCTe correctly determined the degree of infiltration of the bowel wall in all of the identified serosal bowel nodules (n=34, Fig. 2). Of 25 nodules reaching the submucosa at histology, the depth of infiltration was correctly identified by MSCTe in 19 (70.0%) cases, while in 6 cases it was underestimated (Figs. 3, 4 and 5).

A statistically significant positive correlation was observed for the diameter of the endometriotic nodules estimated at MSCTe and that measured by the pathologist (Pearson's correlation coefficient, r=0.974, p<0.001).

MSCTe had a sensitivity of 98.7%, a specificity of 100%, a PPV of 100% and a NPV of 95.7% in identifying women with bowel endometriosis.

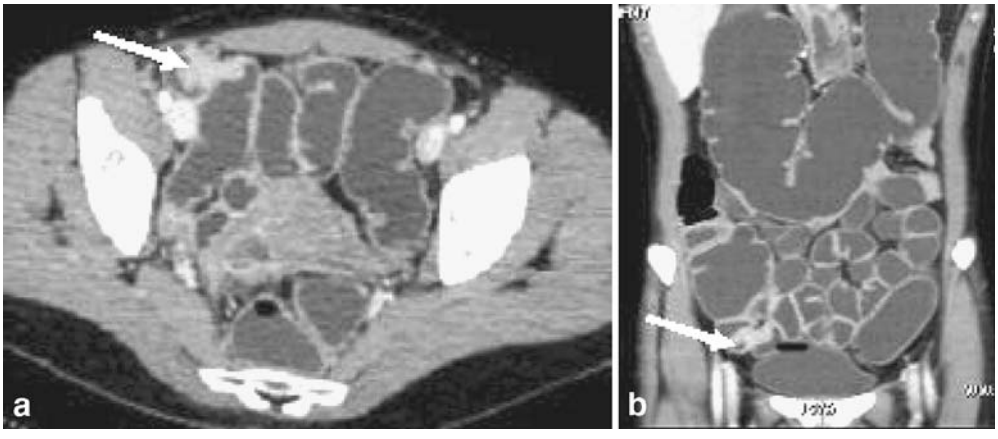

Fig. 1 Ileal endometriotic nodule. **a** Axial MSCTe image of the abdomen; the *arrow* indicates the ileal endometriotic nodule. **b** Coronal reconstruction confirming that the endometriotic nodule involves the last ileal loop

Table 3 Endometriotic nodules identified by MSCTe and histology

Depth of the nodules in the bowel wall	Radiological findings (*n*)	Histology (*n*)
Serosa	34 (30.9%)	36 (31.0%)
Muscularis	57 (51.8%)	66 (56.9%)
Submucosa	19 (17.3%)	14 (12.1%)
Total	110	116[a]

[a]Six nodules were missed by MSCTe

Discussion

The current study demonstrates, for the first time, that MSCT combined with a colon retrograde distension is reliable in determining the presence and depth of bowel endometriotic lesions.

MSCT evaluated the colon distended by the water enteroclysis; this approach is particularly relevant considering that the forced distension of the lumen highlights reduced distensibility of the bowel wall due to endometriotic infiltration. In addition, we used a pharmacological inhibition of the peristaltic waves which minimizes the possibility that physiological intestinal constrictions are mistaken for stenosis. Finally, the use of iodine contrast medium enhances the detectability of the endometriotic nodules (characterized by high neoangiogenesis) and of the perilesional inflammation.

In our study population, MSCTe identified 98.7% of the women with bowel endometriosis and 94.8% of the bowel endometriotic nodules. Importantly, this technique gave us the opportunity to estimate the degree of infiltration of the endometriotic lesions in the bowel wall. All serosal nodules were correctly identified by MSCTe; an underestimation of lesions reaching the submucosa was observed.

In our series, no false-positive diagnosis of bowel endometriosis was made at MSCTe and therefore this technique had a PPV of 100%. This is a particular strength of MSCTe, as false-positive diagnosis of bowel endometriosis may determine inappropriate counselling for the patients and concerns due to the possible complications of the surgical treatment of bowel endometriosis (i.e. perineal abscess, rectovaginal fistula, dehiscence of the suture and temporary protective colostomy).

Table 4 Location of endometriotic nodules identified by MSCTe and surgery

Location of endometriotic nodules	MSCTe (*n*)	Surgery (*n*)
Sigmoid colon	55	55
Rectum	47	53
Caecum	5	5
Ileum	3	3
Total	110	116

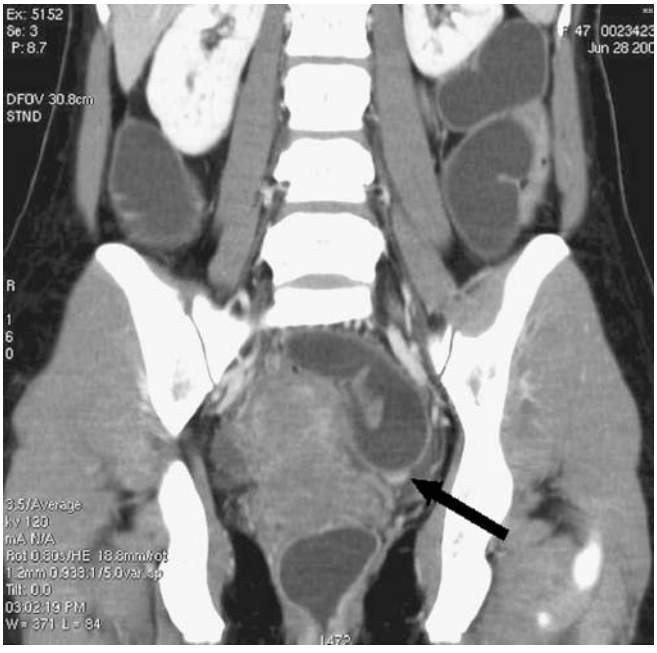

Fig. 2 Endometriotic nodule infiltrating the serosa. Coronal reconstruction of MSCTe of the abdomen; the *arrow* indicates the endometriotic nodule. The nodule is strictly contiguous to the intestinal wall and the fat plane between the lesion and the colonic wall disappears

Another advantage of MSCTe may consist in the fact that this technique can investigate the presence of endometriotic lesions on the last ileal loop which can be distended by water enteroclysis (Fig. 1). Ileal endometriotic lesions are considered to be rare, being present in 16% of patients with intestinal endometriosis [1]; however, the real prevalence of this type of lesion has never been investigated in a large population of women with endometriosis suffering severe gastrointestinal symptoms.

We are aware that in general bowel endometriosis is studied by MRI rather than by CT. MSCT was chosen because of the following three advantages: it provides a reliable investigation of the whole colon (until the last ileal loop), it has a powerful spatial resolution and the abdominal scan can be performed within few seconds. Although MRI may have some advantages (i.e. the absence of radiation), its use would have required a longer time in the abdominal study which is performed during colon distension by water enema; this would have reduced the tolerability of the examination for the patients and increased potential artefacts. In addition, the spatial resolution of MRI may be inferior to MSCT in bowel evaluation, particularly in the bowel segments that cannot be reached by an endoluminal coil. In particular, when deep pelvic endometriosis is located on the sigmoid, it can be missed by MR imaging or be confused with faecal material [29]. Finally, at MRI it may be difficult to differentiate lesions limited to the serosa from lesions invading the muscle wall, particularly when endometriosis of the torus

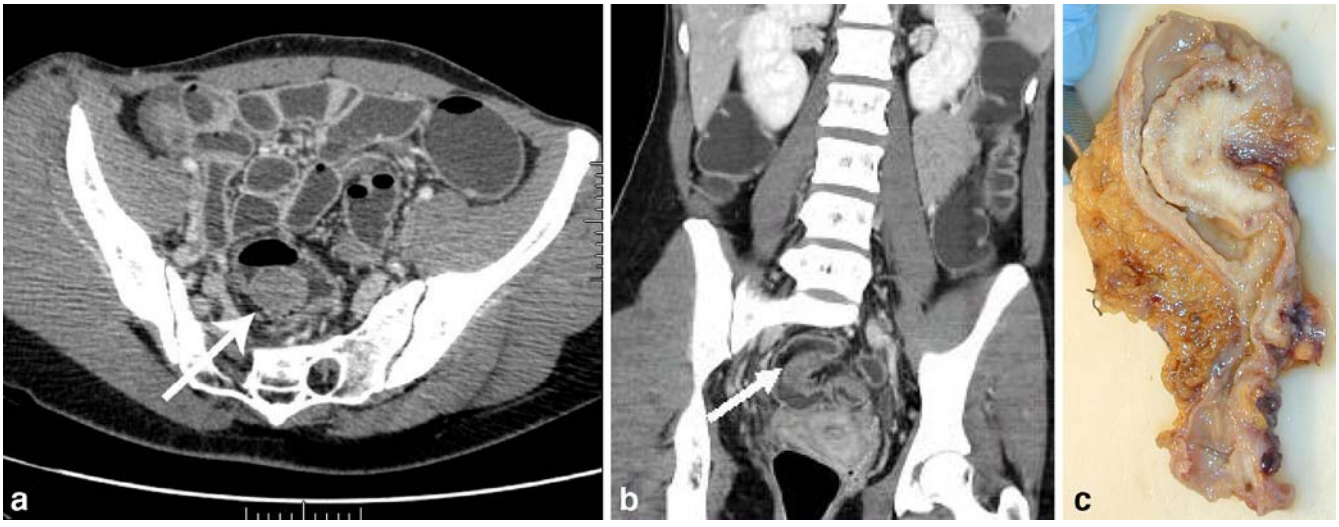

Fig. 3 Endometriotic nodule infiltrating the muscular layer. **a** Axial MSCTe image of the abdomen; the *arrow* indicates the endometriotic nodule. The lesion is enhanced and it infiltrates the bowel wall involving the muscular layer. **b** Coronal reconstruction demonstrating the extension of the sigmoid endometriotic nodule (indicated by the *arrow*). **c** Formaldehyde-fixed resected bowel segment; the endometriotic nodule of the sigmoid colon was previously demonstrated by MSCT (magnification 1:3)

uterinus and uterosacral ligament juxtaposes the rectal wall [14].

Another advantage of MSCT consists in the multiplanar imaging modality which allows viewing examinations in arbitrary planes with excellent image quality. Although some authors discuss the effectiveness of multiplanar reconstructions in the study of bowel pathologies [37], the use of MSCT coupled with intestinal distension has been proved to be effective in the detection of intestinal wall pathologies [25].

MSCTe identified all nodules located on the sigmoid colon, caecum and ileum and all of the missed nodules (n=6) were located on the rectum (three reaching the serosa and three infiltrating the muscular layer). These nodules could have been potentially identified associating MSCTe with other techniques suitable to diagnose endometriotic nodules involving the lower part of the rectum (such as rectal endoscopic ultrasonography or MRI with endorectal coil).

An important disadvantage of our approach consists in the radiation dose to which the patients are exposed. This limit is particularly relevant considering that women with symptomatic endometriosis are typically in their reproductive years and they often desire future pregnancies. Although we cannot deny that an exposure to radiation occurred during the MSCTe, it is important to note that the dose employed during this exam is comparable to that used for a double-contrast enema of the small intestine [38].

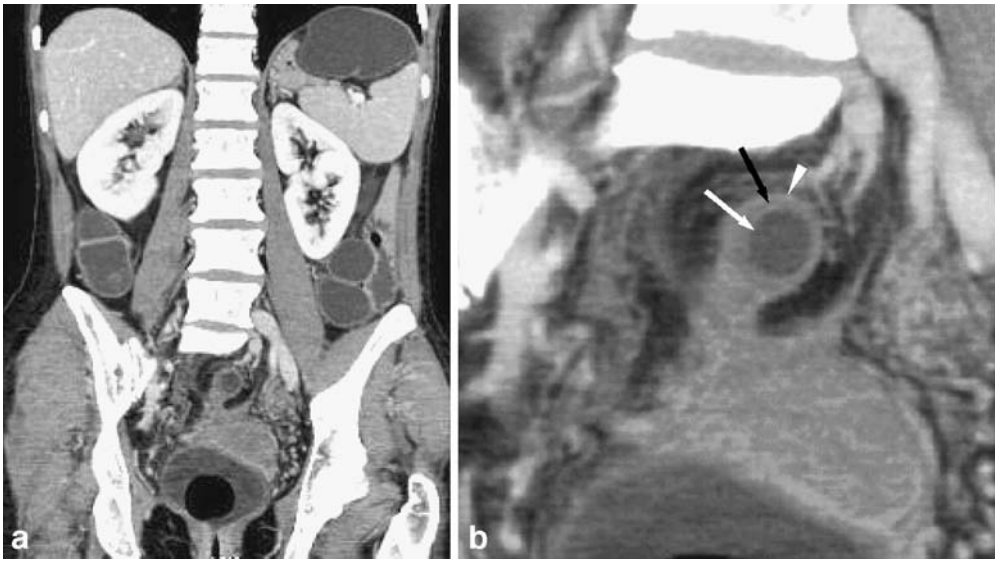

Fig. 4 Endometriotic nodule infiltrating the submucosal layer. **a** Coronal MSCTe reconstruction. **b** Detail of the coronal reconstruction; the *white arrow* indicates the mucosa, the *black arrow* indicates the submucosa and the *white arrowhead* indicates the muscularis

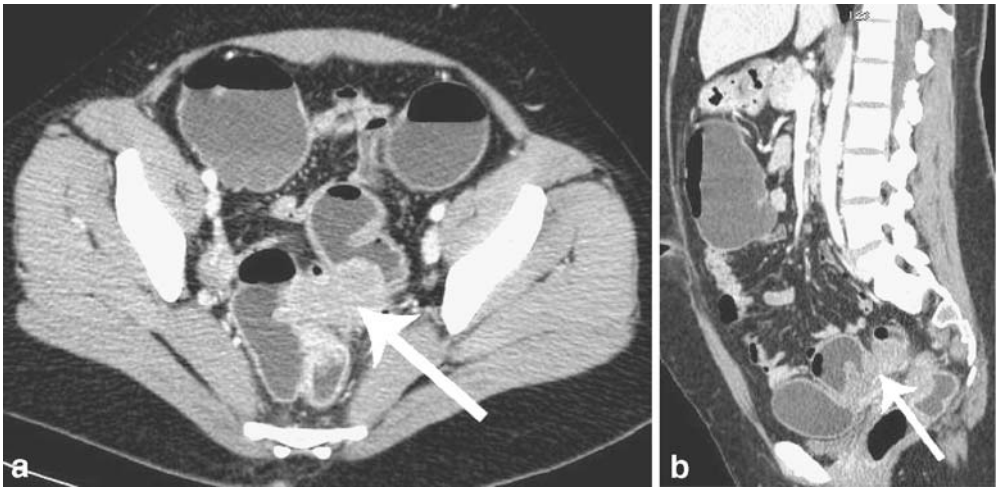

Fig. 5 Endometriotic nodule not infiltrating the mucosal layer. **a** Axial MSCTe image of the pelvis; the *white arrow* indicates the nodule. **b** Sagittal reconstruction of MSCTe image of the pelvis of the same patient; the *white arrow* indicates the endometriotic nodule

A criticism of the current study may consist in the fact that the study population had a very high positive rate (76/98, 77.6%). However, in a clinical study we previously demonstrated that the presence of gastrointestinal symptoms in patients with endometriosis is highly associated with bowel involvement with changes in symptoms in relation to the depth of bowel wall infiltration [2]. In addition, in light of the fact that our Institute represents a tertiary referral centre for the treatment of endometriosis, over 35% of the subjects included in the study had a prior surgical diagnosis of pelvic endometriosis. As a consequence, the high positive rate in our study population is not surprising and these new data confirm the possibility to suspect bowel endometriosis during the gynaecological consultation.

A strength of the current study consisted in the fact that a large number of patients with bowel endometriosis was evaluated; in addition, these women underwent MSCTe and laparoscopy within a limited period of time (20 days). Furthermore, inclusion criteria for the study were accurately defined and no patient who had previously undergone a radiological exam of the bowel requiring contrast media was included in the study.

Importantly, all patients included in the study underwent operative (and not diagnostic) laparoscopy; this is particularly relevant for the surgical diagnosis of bowel endometriosis. It is well known that rectosigmoid endometriotic lesions (and lesions of the rectovaginal septum) may be undiagnosed at diagnostic laparoscopy when extensive adhesions are present in the pelvic cul-de-sac. In all women the cul-de-sac was completely visualized after adhesiolysis and dissection.

Although bowel endometriosis can be reliably diagnosed at surgery, imaging techniques are useful in confirming the diagnosis preoperatively and in providing precise information on the characteristics of bowel endometriotic nodules (location and depth of infiltration in the bowel wall). Based on these data, the gynaecological and colorectal surgeons can explain to the patients both types of surgical treatment (i.e. nodulectomy or bowel resection) and the possible complications; obviously this information is required to obtain an informed consent from patients.

Although MSCTe has been proved to be effective in the diagnosis of bowel endometriosis, we believe that this technique should be applied only to symptomatic women with a high suspicion of endometriotic involvement of the bowel. This approach is in line with the fact that bowel surgery carries the risks of relevant post-operative complications and therefore it should be performed only in symptomatic patients.

In conclusion, for the first time, the current study demonstrates that MSCT combined with a colon retrograde distension is effective in the diagnosis of bowel endometriosis.

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