Multislice computed tomography with colon water distension (MSCT-c) in the study of intestinal and ureteral endometriosis ☆

Simona Iosca [a], Domenico Lumia [a], Elena Bracchi [a,*], Ejona Duka [a], Monica De Bon [a], Manjola Lekaj [a], Stefano Uccella [b], Fabio Ghezzi [b], Carlo Fugazzola [a]

[a] Department of Radiology, University Hospital, Varese, Italy
[b] Department of Obstetrics and Gynecology, University Hospital, Varese, Italy

ARTICLE INFO

ABSTRACT

This study evaluates retrospectively the accuracy and reproducibility of multislice computed tomgraphy with colon water distension (MSCT-c) in diagnosing bowel (BE) and ureteral (UE) endometriosis. Sixty-four patients underwent MSCT-c and videolaparoscopic surgery. Two radiologists reviewed MSCT-c examinations: sensitivity and specificity were calculated, considering histological exam as reference standard. In the BE cases, the degree of bowel wall infiltration was also assessed. Sensitivity and specificity for both readers were 100% and 97.6% for BE and 72.2% and 100% for UE; the interobserver agreement was excellent. The degree of bowel wall involvement was correctly defined in 90.9% of cases. MSCT-c is an accurate and reproducible technique but—considering the age of the patients—delivers a nonnegligible radiation dose.

1. Introduction

Endometriosis is a gynecological disorder occurring in 5%–10% of the female population; if we consider only women of menstruating age, its incidence approaches 15% [1,2].

Insight in the etiology and pathogenesis of endometriosis is limited. The most widely accepted explanation is "Sampson's hypothesis," which suggests that endometriosis arises from implantation of endometrial cells in the peritoneum due to retrograde menstruation through the Fallopian tubes. Coelomic metaplasia, an alternative hypothesis to explain the occurrence of this disease, suggests that peritoneal epithelium can be transformed into ectopic endometrium by metaplastic processes triggered by inflammation, toxic agents, or other stimuli [2].

Irrespective of the different possible pathogenetic explanations, endometriosis can present in three main forms: superficial endometriosis (small nodular foci and/or mycrocysts located on the surface of pelvic peritoneum, ovaries, and serosa of endopelvic bowel), ovarian endometrioma (blood containing cavity, known as chocolate cyst), and deep infiltrating endometriosis (DIE) [3–5].

DIE, which is present in approximately 20%–35% of patients with endometriosis, is a specific condition characterized by infiltration of the implants under the peritoneal surface exceeding 5 mm in depth, causing formation of adhesions and invasion of adjacent organs [3,4,6].

Bowel endometriosis (BE) is one of the most severe forms; it affects 5%–37% of the patients with a diagnosis of DIE and is associated to multiorgan endometriotic lesions in 70% of the cases. The most frequent intestinal sites for endometrial lesions are the rectum and rectosigmoid junction, with an incidence of 10.6%–75%, followed by the sigmoid colon (14.3%–65%), cecum and ileocecal junction (1.5%–5.9%), appendix (2.9%–6.4%), and omentum (1.7%–2.9%) [3,5,7–10]. The term BE should be used when endometrial-like glands and stroma involve the bowel wall reaching at least the subserous fat tissue; endometriotic foci located on the bowel serosa should be considered peritoneal endometriosis and not BE [7]. Dyschezia, diarrhea, tenesmus, and constipation are the main symptoms of BE [6,7].

Ureteral endometriosis (UE) is a rare entity (0.08%–6%), usually unilateral and mostly associated to endometriosis of rectovaginal septum. Therefore, women with colorectal endometriosis, who typically present with rectovaginal endometriotic nodules, are at high risk of ureteral involvement [10,11]; distal ureter is the most commonly affected site [12]. Depending on the degree of ureteral wall involvement, UE can be classified as intrinsic (endometrial tissue infiltrates ureteral muscularis propria or mucosa) or extrinsic (endometrial tissue invades the ureteral adventitia and surrounding connective tissues); extrinsic ureteral involvement is four times more

frequent than the intrinsic form [12–14]. UE can cause hydrone-phrosis, abdominal pain, cyclic dysuria, and renal colic. However, patients can be asymptomatic for a long time; thus, ureteral compression may result in serious impairment of renal function in 25%–50% of the cases [12,15].

Multislice computed tomography after colon distension with water (MSCT-c) and intravenous injection of iodinated contrast medium has been recently used with satisfactory results to diagnose bowel and ureteral endometriosis [10,16,17]. Since few studies have so far appeared in literature and they all come from the same center, this research was carried out with a 64-row CT scanner and proposes to confirm the effectiveness of this imaging modality, comparing our results to those of previous experiences.

2. Materials and methods

This study was performed in the period between September 2007 and August 2011 and included 94 patients (age range: 26–46 years; mean age: 36.2 years). All women were evaluated using MSCT-c, and 64 underwent videolaparoscopic surgery (VLS). All patients had both typical symptoms associated with endometriosis (dysmenorrhea, dyspareunia, chronic pelvic pain, and infertility) and gastrointestinal symptoms suggestive of BE (diarrhea, rectal pain associated with menses, constipation, and dyschezia). Symptoms suggestive of urinary tract endometriosis were absent in all study patients. Moreover, 10 of the women included in the study were previously submitted to VLS for endometriosis (8 patients underwent nodulect-omy and adhesiolysis, 1 patient had salpingectomy and enucleation of a right ovarian cyst, and the last patient had undergone left annessiectomy) and had a relapse of typical symptoms.

Surgery revealed no evidence of endometriotic lesions on the pelvic organs in 9 of the 64 patients, who underwent only adhesiolysis. Endometriotic implants infiltrating at least one pelvic organ were removed in 55 of the 64 women (in 14 of 55 patients, only one pelvic organ was involved, and in the remaining 41 patients, multiorgan involvement was found).

Patients with intestinal and/or ureteral endometriotic lesions found at VLS were 26, all presenting multiorgan involvement. In particular, surgery showed bowel endometriotic lesions in 7 women (in 6 patients, intestinal resection was performed, and in the remaining patient, only nodulectomy was performed), ureteral endometriosis in 6 women (treated with ureterolysis), and intestinal and ureteral lesions in 13 patients (submitted to both bowel resection and ureterolysis).

Histological examination was considered to be the standard of reference for both intestinal (22 lesions, of which 16 were single ones and 3 were double ones) and ureteral (26 lesions overall, of which 12 were unilateral and 7 were bilateral) locations. The degree of infiltration of the intestinal wall masses was also evaluated by histological examination of bowel specimens removed at surgery. All ureteral lesions, which were extrinsic, were confirmed at histological exam of specimens of periureteral tissue.

Transvaginal ultrasonography was performed in all patients before MSCT-c evaluation. All patients signed a written informed consent form.

2.1. MSCT-c technique

Each patient's preparation included a low-residue diet and the administration of four to six polyethylene glycol doses (Isocolan, Bracco, Milan, Italy) dissolved in 500 ml of water per dose the day before the exam. All MSCT-c exams were performed with a 64-row scanner (Aquilon 64; Toshiba, Tokyo, Japan); the scan parameters were as follows: 64×0.5-mm collimation, rotation time 0.5 s, tube voltage 120 kV, and automatic exposure control dose modulation system.

Colonic water distension was achieved by placing the patients in the left lateral decubitus position on the CT table for the introduction of a rectal Foley catheter and then administering 2000–2500 ml of water (37°C). During colonic water distension, 20 mg of hyoscine-*N*-butylbromide (Buscopan; Boehringer, Ingelheim, Germany) was administered intravenously to reduce bowel peristalsis and colonic spasm. Small bowel distension was also achieved in all patients by oral introduction of 1.5 l of water 30–50 min before the exam.

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

All patients received an intravenous injection of iomeprol with an iodine concentration of 350 mg I/ml (IOMERON 350; Bracco, Milano, Italy); the rate of intravenous injection of contrast material was set at 2.5–3 ml/s, and injected volume load was set at 1.5 ml/kg; in all patients, 40–50 ml of saline solution injection at a rate of 2.5–3 ml/s followed contrast medium administration. No scan was performed before contrast medium injection. The volumetric acquisition was obtained during the portal–venous phase (90 s after contrast medium) in 31 of the 64 patients; in 19 of the 31 patients, the exam was completed with an acquisition in excretory phase (12–15 min after contrast medium). The intravenous contrast material was administered using a split-bolus technique in the remaining 33 patients, who were submitted to a single volumetric acquisition: this technique fractions the contrast medium dose into two boluses [18]; between the first and second bolus administration, colonic water distension was achieved.

Both axial and multiplanar reconstructions (MPR) images were evaluated. Moreover, maximum intensity-projection (MIP) recon-structions were used to visualize the ureters, and curved multiplanar reconstructions (cMPR) were used to better define the location and longitudinal extension of bowel lesions.

2.2. MSCT-c image interpretation

MSCT-c images of the 64 patients that underwent both CT scan and VLS were reevaluated retrospectively by two experienced radiologists independently and in consensus. The radiologists were not aware of the surgery and histology findings.

2.2.1. Independent image analysis

Firstly, the radiologists evaluated the diagnostic quality of MSCT-c images, classifying colonic water distensions on a three-point scale: good (uniform and complete colonic distension), moderate (complete distension not achieved due to partial water reflux through incontinent ileocecal valve into small bowel), or unsatisfactory (inadequate distension of colon segments).

Moreover, opacification of pelvic ureter was classified as complete, incomplete, or absent in the 52 exams (for a total of 104 ureters) in which excretory phase was performed or split-bolus technique was employed.

Radiologists then searched the presence of endometriotic nodules involving the bowel as well as evaluated the location, extension, and degree of infiltration of bowel wall (connective subserosal tissue, muscularis propria, and/or submucosal layer). Ureteral endometriosis was also searched, and, in the positive cases, disease extension, ureteral dislocation, and presence of hydronephrosis were assessed.

Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy of MSCT-c technique were calculated in comparison to histological findings, which were considered as standard of reference.

2.2.2. Consensus image analysis

Secondly, the degree of intestinal wall infiltration in patients with bowel lesions was reevaluated in consensus by the two readers. Furthermore, radiologists searched for other pelvic localizations of