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Original Article

Three-Dimensional Ultrasound in the Management of Bladder Endometriosis

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ABSTRACT **Study Objective:** To assess the performance of three-dimensional (3D) ultrasound with color Doppler in the diagnosis of bladder endometriosis compared with magnetic resonance imaging (MRI) and cystoscopy.

Design: Canadian Task Force classification II-3.

Setting: Department of gynecology and obstetrics of a university hospital.

Patients: Eight women who reported urinary tract symptoms suggestive of bladder endometriosis between May 2012 and November 2013.

Interventions: For all cases, we assessed the size of the endometriotic nodule, its location on the bladder wall, and the distance between the lesion and the ureteral meatus, with pelvic 3D ultrasound (full bladder), uro-MRI, and cystoscopy. The results were compared with the postoperative histopathologic findings.

Measurements and Main Results: The pathology results differed from those produced by imaging by a mean ± SD of −3.5 ± 6.4 mm on transvaginal ultrasound (TVUS) and −5.75 ± 11.9 mm) for MRI. There was no significant difference between imaging and pathology findings ($p = .20$) or between the 2 imaging findings (TVUS and MRI) ($p = .73$). Results showed a trend toward better accuracy for 3D ultrasound than MRI with smaller SDs ($p = .08$). Cystoscopy and ultrasound were compared; however, without any tools to assess the distance in cystoscopy, no statistical result was possible.

Conclusion: Ultrasound seems to be superior to cystoscopy and is at least as effective as MRI in diagnosing and planning the surgery for bladder endometriosis. Journal of Minimally Invasive Gynecology (2015) 22, 403–409 © 2015 Published by Elsevier Inc. on behalf of AAGL.

Keywords: 3D ultrasound; Bladder endometriosis; Color Doppler; Cystectomy Cystoscopy; MRI

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Endometriosis affects 10% of women of reproductive age, with incidence peaking at 35 to 45 years. Deep infiltrating endometriosis (DIE) is characterized by the presence of endometrial glands or stroma outside the uterus, with implants that penetrate the retroperitoneal space for a distance of ≥5 mm [1,2]. DIEs are most often located in the posterior compartment of the pelvis (90%), but anterior compartment lesions have been described, including in the urinary tract, where they account for 10% of all DIEs [3]. Urinary tract endometriosis is found in 4 specific locations: the bladder (84%), ureter (10%), kidneys (4%), and urethra (2%) [3].

Two types of bladder endometriosis correspond to 2 different pathophysiologic sources. A bladder dome location seems to be a consequence of the development of endometriosis implants from the vesicouterine fold [4]. In contrast, trigone endometriosis is secondary to the development of anterior adenomyosis [5]. Patients with bladder endometriosis most often present with dysuria (30%), urgency (30%), urinary pain (30%), urge incontinence (5%), and hematuria (5%) [6]. Ureteral endometriosis has less pronounced symptoms, but it can cause progressive homolateral kidney destruction by ureterohydronephrosis [5,7].

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Because clinical examinations are rarely informative for the diagnosis of bladder endometriosis, preoperative imaging is required. This imaging may include pelvic ultrasound, uro-magnetic resonance imaging (uro-MRI), and cystoscopy [6,8–12]. The aim of this study was to assess the performance of 3-dimensional (3D) ultrasound in the diagnosis of bladder endometriosis. We then compared our results with findings from uro-MRI, cystoscopy, and postoperative histopathology.

Materials and Methods

Between May 2012 and November 2013, we included 8 consecutive women referred to the endometriosis centre of Croix-Rousse University Hospital (Lyon, France) for clinical suspicion of bladder endometriosis. Patients were selected based on their urinary symptoms (urinary pain, frequent urination, hematuria, and dyspareunia) combined with dysmenorrhea. All patients who reported urinary tract symptoms suggestive of bladder endometriosis undergo cystoscopy, 3D ultrasound, and MRI. All patients underwent surgery to compare imaging results with the histologic results. Echography was performed with a conventional 3D vaginal probe. We previously published the 3D rectosonography technique, which was classified by the institutional board review committee as "usual care" [13]. Therefore, approval of the institutional review board committee was not required.

Three-Dimensional Ultrasound

All procedures were performed according to the same protocol and by the same operator (G.D.). A clinical gynecological examination was performed, followed by a standard transvaginal ultrasound (TVUS), which was performed with a full bladder. Images were obtained with the VOLUSON E8 (GE Healthcare Ultrasound, Milwaukee, Wisconsin), which was fitted with a 3D transvaginal multifrequency transducer (2.9–10 MHz).

All women underwent extended 2D TVUS of pelvic compartments to detect adenomyosis, endometrioma, and posterior DIE. Bladder examination was performed with a full bladder. Bladder endometriosis was identified as an iso- or hyperechogenic nodule compared with any nodules on the uterine wall (Fig. 1). The nodule was measured, and its localization on the bladder wall (bladder dome and trigone) was noted. A trigone location was defined by a distance between the lesion and the ureteral meatus of $<$10 mm. The location of the ureteral meatus was diagnosed by identifying streaming of urine from the ureteric orifice using color Doppler (Fig. 2). Finally, a renal ultrasound was performed to identify ureterhydronephrosis to diagnose ureteral obstruction.

Three-dimensional TVUS acquisitions were then performed. We used a B-mode scan and a transvaginal volume transducer to identify the region of interest (ROI). After acquisition, the multiplanar display showed sagittal, axial, and coronal views (Fig. 3). The coronal plane could not be obtained with conventional 2D sonography. Several 3D image programs were used for off-line analysis. For the last 4 women, we were able to estimate the volume of the vesical lesion with the virtual organ computer-aided analysis mode (Fig. 4). Volumes were calculated with acquisitions every 30°. Until then, because of equipment issues, the size of the lesion was assessed by measuring its longest dimension in millimeters. The tomographic ultrasound imaging (TUI) mode provided a series of slices, every 1 and 2 mm, through any 1 of these planes. The TUI display was modified to maximize the number of slices in the ROI, and thus, enable a better appreciation of bladder wall infiltration (Fig. 5). The 3D acquisitions were then combined with color Doppler for improved precision in measuring the distance between the nodule and the meatus (Fig. 3).

Fig. 1

Two-dimensional ultrasound with a full bladder. Trigon endometriotic nodule (*white arrow*) secondary to the development of anterior adenomyosis (*red line*).

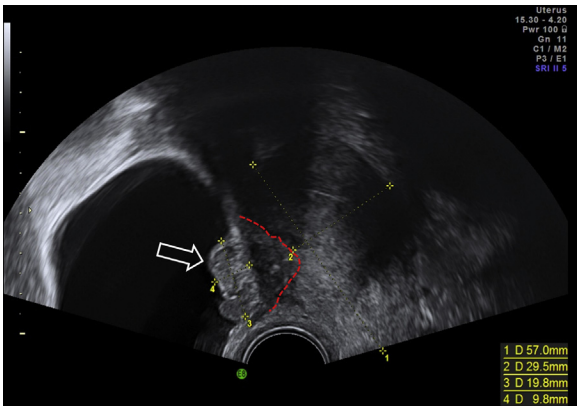

Fig. 2

Two-dimensional ultrasound with color Doppler visualizing the right ureteral meatus.