Transurethral ultrasonography of the urinary bladder

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Summary. Though considered a pelvic organ, the urinary bladder, unlike the prostate, can be assessed with a variety of radiographic and imaging techniques. Intravenous urography, cystography and abdominal ultrasonography have been shown to be more useful in studying this structure in contrast to the prostate gland. Other imaging studies such as transrectal ultrasonography, computerized tomography and magnetic resonance imaging have been proven to be of value in examining both organs. Most of these latter examinations have been utilized for the purpose of staging bladder tumors and, though noninvasive tumors and tumors demonstrating significant extravesical involvement can be readily identified, these imaging examinations have generally not been satisfactory in determining the degree of muscle involvement by an invading bladder tumor.

Transurethral ultrasonography has been proven useful in this regard. Interestingly, the technique was initially reported by clinicians interested in examining gynecologic structures [1, 2, 3] and its application for specific examination of the bladder followed these reports [4-11]. Transurethral ultrasonography has been found to be of value in staging carcinoma of the bladder and the information obtained from the examination is often useful in directing the clinician in the management of the patient based on the depth of infiltration of the tumor.

Instrumentation

The instrumentation for transurethral ultrasonic scanning of the bladder is not dissimilar to the instrumentation developed for transrectal ultrasound of the prostate. The transducers have generally been of different frequency and the technique has usually been carried out in association with standard urologic endoscopic techniques. Typically, the scanner for transurethral ultrasonography consists of a motor that rotates a rod that is connected at its opposite end to an interchangeable transducer (Fig. 1). Most scanners can be sterilized in an antiseptic solution prior to use and they fit within a standard resectoscope sheath of varying diameters (minimum 24F). The examination is often performed in association with cystoscopy and when a bladder tumor is observed and further information regarding depth of invasion desired the optics can be simply removed and replaced with the transurethral scanner. Most manufacturers provide adapters for their equipment so that they will be able to be utilized with the varying endoscopic instruments that are available. Typically, transducers are of a frequency of 5.5 MHz and they may vary in both focal length and direction of the emitted ultrasonic impulse. A standard 90° transducer is available for general use and a 135° transducer is also often utilized for retrograde imaging of the area around the bladder neck.

After the scanner and transducer are in proper position, the bladder is distended with sterile water through the endoscope and the motor activated. Ultrasonic scans of the bladder are obtained at different angles and positions and at varying degrees of distention so that all surfaces are imaged. Both transducers are utilized to ensure that all areas of the bladder are properly visualized. The seminal vesicles of male patients, the uterus of female patients, and the bladder neck and ureteral orifices serve as landmarks to localize abnormalities in the bladder. The procedure need not be performed with the patient under general or spinal anesthesia if the cystoscopic examination can be performed with local anesthesia. The technique is
Superficial bladder tumors

Superficial, noninvasive bladder tumors appear ultrasonically as echogenic structures projecting into the lumen of the distended bladder. The tumor is fixed to the surface of the bladder and with distention and infusion of fluid into the bladder they do not change their position, unlike blood clots and stones which will alter their location during different phases of the examination (Fig. 3). Superficial noninvasive tumors have a well-defined base and at times a distinct stalk can be identified attaching to the surface of the bladder. Sessile tumors tend to have a broader base with the absence of this fine delicate structure. When examined during periods of bladder distention, it will be noted that superficial tumors do not cause fixation or distortion of the bladder wall. This aspect of the examination should be carried out in all instances. The bladder wall, particularly the echogenic muscular layer, is not distorted by the tumor and continues to be viewed as a gently circular structure that often appears sterile, rapid (5–10 min) and greatly enhances the information gained at cystoscopy particularly with regard to the assessment of bladder tumors.

Appearance of bladder and bladder tumors

Normal bladder

The shape of the bladder is obviously dependent on the degree of distention, but typically it is viewed as a global structure with a very distinct interface between the fluid and the bladder wall. Normally, the bladder wall appears symmetrical, smooth and has gently curved surfaces. The muscular layer is highly echogenic and is viewed clearly in most scans (Fig. 2). If scans are obtained during actual filling of the bladder, the distensibility of the walls can be appreciated and any areas of fixation or distortion can usually be readily identified. Most scanners have the capability of magnification of specific areas of interest and this application is often useful in clearly defining tumors of the bladder. In male patients the seminal vesicles are readily identifiable as paired oblong lucent structures that are readily visualized posteriorly. The uterus in females can often be visualized posterior to the bladder and the impression of this structure on the bladder wall can often be readily appreciated.

Transurethral scans of the prostate can also be carried out and typically the capsule of the prostate is well-delineated. Because the transducer is in direct contact with the urethra, multiple resident echoes are present in this region and clear definition of the interprostatic structures are not as readily appreciated as can be obtained with transrectal ultrasonic imaging.

Fig. 2. Transurethral scan of normal bladder: note hyperechoic detrusor and seminal vesicles posteriorly (arrows); the transducer is the white area in the central aspect of the bladder.

Fig. 3. a Transurethral scan of superficial bladder tumor demonstrating preservation of bladder wall (arrows). b Magnified view of tumor.