

**UROGENITAL PATHOLOGIES AND DIAGNOSTIC RADIOLOGICAL
TECHNIQUES**

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Abstract: Advancements in diagnostic radiology have significantly enhanced the detection, characterization, and management of urogenital pathologies. This overview highlights contemporary imaging modalities utilized in evaluating diseases of the urinary and reproductive systems, emphasizing their clinical applications and diagnostic efficacy.

Keywords: Bladder cancer, Urolithiasis, Benign Prostate disease, Prostate cancer, Testicular torsion, Testicular cancer, Penile cancer, Ultrasound, Doppler Ultrasound, CT Urography, CT KUB, Magnetic Resonance Imaging(MRI)

Introduction

Urogenital radiology is a specialized branch of diagnostic imaging focused on the evaluation of the urinary and reproductive systems in both males and females. It plays a critical role in identifying structural abnormalities, functional impairments, infections, tumors, congenital anomalies, and infertility-related conditions. This subspecialty intersects with urology, nephrology, gynecology, and oncology, making it essential in comprehensive clinical practice.

Bladder cancer (BCa) is one of the most frequently diagnosed cancers, with approximately 550,000 new cases reported annually. Urothelial cell carcinoma is the most common histologic type of BCa, representing more than 90% of all cases. Staging and therapy depend on the invasion of the muscularis propria; in fact, non muscle invasive BCa (NMIBC) (stage T1) is managed with trans urethral resection of bladder tumour (TURBT), whereas muscle invasive BCa (MIBC) (stage T2 or higher) requires radical cystectomy or radiotherapy or, in selected cases neoadjuvant chemotherapy. The detrusor invasion represents the most important predictive and prognostic factor: MIBC is associated with a significantly poorer prognosis compared to NMIBC. This highlights the crucial role of pathological and radiological assessment of muscle invasion, which has a significant impact on treatment strategies.

Urolithiasis – calculi anywhere along the urinary tracts (i.e., caliceal, pelvic, pyeloureteral junction, ureteric, vesico-ureteric junction, bladder). Approximately 12% of men and 5% of women are affected by urolithiasis. The most common renal stones are composed of calcium oxalate and they are often mixed with calcium phosphate. As stones pass from the kidneys into the ureters, they can lead to renal colic. Calcium containing stones are radiopaque. Non-contrast CT has the highest sensitivity for renal calculi detection (99%), whereas ultrasound (US) has a sensitivity of approximately 25%. The majority of calculi missed on US are less than 3 mm in size.

Benign Prostate Hyperplasia (BPH), a non-cancerous enlargement of the prostate gland associated with urinary symptoms, including slow urinary stream, urinary frequency urgency and urinary retention with incomplete bladder emptying.

Prostate cancer, the second most frequent cancer in men. Prostate cancer is usually suspected on the basis of PSA levels. Definitive diagnosis depends on histopathological verification of adenocarcinoma in prostate core biopsies.

Testicular torsion occurs when a testicle twists on the spermatic cord, cutting off its blood supply. The most common symptom is sudden and intense pain. The diagnosis is initially suspected based on clinical findings but must be confirmed with colour Doppler Ultrasound. Early diagnosis is crucial, as testicular infarction can be avoided with a 100% salvage rate if treated within 6 hours.

Testicular Cancer accounts for 1% of all male cancers and is the most common type in men during their 3rd and 4th decades of life. Over 90% of testicular cancers are primary germ cell tumours. In men over the age of 70, lymphoma is the most common type of testicular cancer.

Penile cancer is a very rare tumour. Although penile fractures are rare, they require immediate diagnosis and treatment as they constitute a medical emergency. These injuries involve rupture of the penile tunica albuginea of the corpora cavernosa or spongiosum, typically caused by trauma to an erect penis, most often during sexual intercourse. Emergency ultrasound with Doppler is usually the initial imaging modality, to verify the presence of fracture and haematoma. MRI of the penis is the most valuable imaging technique for assessing the extent of the injury, determining its precise location and depth, and identifying potential complications. These are crucial points to be addressed, to guarantee the most appropriate therapeutic approach.

Ultrasonography (US) is the first-line imaging modality for patients with suspected urogenital pathology. Second-level imaging techniques are required for a more detailed characterisation of lesions and for loco-regional staging of disease.

Advantages of Ultrasonography:

Radiation-free: Safe for all patient populations, including children and pregnant women.

Quick and accessible: Rapid evaluation in both outpatient and emergency settings.

High diagnostic accuracy: Particularly effective in detecting hydronephrosis, bladder tumors, and renal masses.

Dynamic assessment: Enables real-time visualization of organ motion and vascular flow.

Disadvantages of Ultrasonography:

Limited visualisation of upper urinary tract, particularly the ureter

Operator-dependent imaging modality

Inaccurate when patient preparation is not optimal (i.e., gas)

Computed Tomography

To comprehensively evaluate the entire urinary tract, CT urography should be performed, including acquisitions in the non – contrast, corticomedullary, nephrographic and excretory phases

Low-Dose and Ultra-Low-Dose Non-Contrast CT (CT KUB)

Low-dose and ultra-low-dose non-contrast-enhanced CT of the kidneys, ureters, and bladder (CT KUB) is a rapid, non-invasive diagnostic technique that is widely utilized in emergency settings, particularly for the detection of urinary tract stones (urolithiasis). This technique provides high sensitivity and specificity, even at reduced radiation exposure levels, making it a safe and efficient alternative to conventional imaging methods.

Magnetic Resonance Imaging (MRI)

Another highly advanced and powerful imaging technique is multiparametric Magnetic Resonance Imaging (MRI), as illustrated in Fig. 17, which involves the administration of iv gadolinium-based contrast medium to acquire sequences that provide both morphological and functional information. This technique offers remarkable potential for the precise diagnosis and characterisation of urogenital lesions, particularly of bladder and prostate cancer.

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