B

Benign Prostatic Hyperplasia

- Benign prostatic hyperplasia (BPH), also called benign hypertrophy or hyperplasia, adenomatous hypertrophy, or simply adenoma, increases with age. Most benign hyperplasia occurs in the transition zone and only occasionally in the periurethral glandular zone. Sporadic BPH can be seen in the peripheral zone. Some enlarged glands contain cysts, calcifications, or even regions of hemorrhage.
- Transrectal US can easily detect benign prostatic hyperplasia; it appears like a heterogeneous mass that dislocates the prostatic peripheral zone.
- Due to poor parenchyma differentiation, CT is not as performed as MRI in evaluating BPH. BPH is hypointense on T1-weighted images and heterogeneous, ranging from hypo- to hyperintense, on T2-weighted images. It is difficult to discriminate between cancer and BPH, even with MR imaging.

Biopsy of the Renal Parenchyma

See section "CT-guided biopsy of the kidney".

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Bladder Carcinoma

- Primary bladder cancer is three times more common in men than women and more common in whites than blacks. Transitional cell carcinoma (TCC) is the most frequent cancer regarding the bladder, followed by adenocarcinoma, squamous cell carcinoma, sarcoma, and small cell carcinoma which are considerably less common and tend to occur in certain settings. Epithelial origin bladder neoplasms are uncommon in the second decade of life and rare in the first. Most bladder neoplasms at these ages are of mesodermal origin.
- The most common clinical presentation is painless hematuria, ranging from gross to microscopic and often intermittent. Ureteral obstruction due to an adjacent cancer is often silent. Spontaneous perforation of a bladder carcinoma is a curiosity.
- CT identifies a soft tissue tumor arising from the bladder wall. Depending on growth, these tumors range from a sessile polyp to bladder wall thickening. In general, CT misses lesions smaller than about 1–2 cm in diameter. Computed tomography also cannot distinguish adherent blood clots from a tumor. CT should be performed using oral and intravenous contrast with thin sections through the bladder with both a 70-s and a 5-min delay. The early images will serve to demonstrate hypervascular areas of the tumor, and the later images are sometimes valuable in outlining the tumor extent along the wall surface. Tumors may be polypoid or sessile and often extend to involve a large area of the bladder wall, including the ureterovesical junction (Fig. 1). Because transitional cell carcinoma is often multifocal, evaluation of the entirety of the urothelial tract should be attempted. Using multidetector CT scans with rapid reformatting, coronal images can be used to check the renal pelves and ureters for the presence of strictures and masses. All images should also

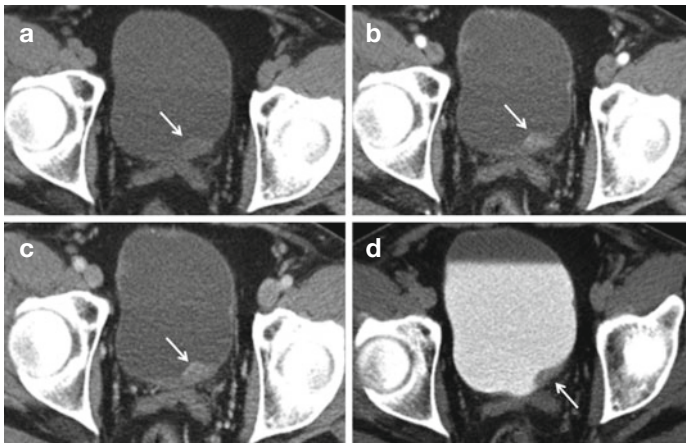

Fig. 1 In basal conditions, CT scans can barely outline a solid mass (*white arrow*) protruding into the bladder (**a**). After intravenous administration of contrast medium, the lesion is well represented both during arterial and venous phase (**b**, **c**). During the urographic phase (**d**), the tumor appears as an image of "minus" compared to the hyperdense bladder which is full of contrast medium

be evaluated for the presence of increased number and size of pelvic and retroperitoneal lymph nodes and distant disease. In cases of advanced disease, CT is probably preferred because of its rapid acquisition and ease of interpretation.

- MRI: Magnetic resonance imaging offers several advantages over other imaging modalities. The multiplanar scanning capability and abundant inherent contrast between perivesical fat, soft tissue of the bladder wall, and urine in the lumen result in excellent contrast resolution. Images should be acquired in at least two orthogonal planes and with high-resolution small fields of view (FOVs). Phased-array surface coils are used to achieve the high resolution necessary for local staging. T1-weighted images are preferred for the depiction of the tumor, invasion into the adjacent fat or

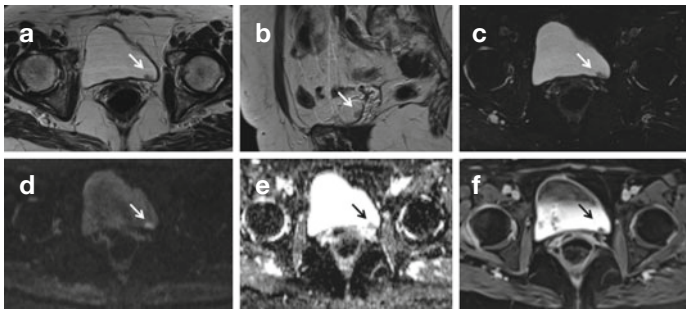

Fig. 2 A hypo-isointense lesion (*white arrow*) located on the left side of the bladder, evaluated in T2-weighted imaging (**a**, **b**) with also fat signal suppression (**c**). The neoplasm shows a remarkably high value (*white arrow*) in diffusion imaging (**d**) which correlates with low ADC values (**e**), highlighting a tissue with high cellularity (*black arrow*). The mass has no postcontrast enhancement (**f**), showing a hypointense pattern (*black arrow*)

organs, and lymph node and bone marrow involvement. T2-weighted images are used to assess invasion into the bladder muscle, prostate, and seminal vesicles. With injection of gadolinium contrast, carcinomas involving the bladder mucosa and submucosa show early and prominent enhancement. On T2-weighted MRI, the muscular wall of the bladder is of homogeneously dark signal (Fig. 2). Extension into but not through the muscular wall is Stage II disease. Extension of high-signal mass through the wall indicates Stage III disease. Metastasis to a lymph node can be recognized if it leads to nodal enlargement. For local extension, T1-weighted, dynamic, post-Gd-DTPA enhanced images may be of help in delineating a mass from adjacent inflammatory stranding. Coronal images of the upper urinary tract, similar to those with CT or intravenous urography (IVU), can be obtained using a heavily T2-weighted coronal series, obtained either as a volume or comprising multiple slices. MRI shows that carcinomas have a T1-weighted signal intensity similar to

that of muscle. T2-weighted images reveal a higher signal intensity than normal bladder wall or fibrosis. Tumor detection is superior with post-Gd-DTPA images, although one should keep in mind that both cystitis and tumors exhibit early MR contrast enhancement. The use of surface coils leads to better image quality than does the use of body coils. Endorectal coils improve visualization of the bladder base and dorsal structures but are of limited use for the rest of the bladder and should not be used. T1-weighted images provide good contrast between hyperintense perivesical fat and isointense bladder wall and detect perivesical fat invasion, spread to lymph nodes, and bone marrow metastases; the latter are identified against the hyperintense normal marrow. T2-weighted images evaluate bladder wall infiltration and prostatic and adjacent structure invasion, although differentiation between tumor and edema is difficult.

Bladder Diverticulum

- Bladder diverticula form when mucosa herniates through overlying muscle. It is uncommon. Diverticula may be primary developmental in origin (Hutch diverticula) or acquired secondary to obstruction and infection or iatrogenic. The latter is more common
- MRI: Bladder diverticulum is well represented using T2-weighted sequences where the diverticula content shows a hyperintense, bladder-like, fluid signal intensity. The diverticulum has a thin wall, in contrast so the native bladder wall which is often thickened as a result of associated bladder outlet obstruction; both possess a low signal intensity on T2-weighted images. The bladder wall, however, may remain its normal thickness in which case a radiological differentiation between a large diverticulum and a bladder duplication is not possible.

- CT: Bladder diverticulum in basal conditions does not own a peculiar aspect that allows to quickly differentiate from the nearby bladder due to similar isodensity and small ones could be skipped on a quick evaluation; performing a Uro-CT is sufficient to detect a pouch filled with iodine contrast medium, which modifies the bladder's profile with a hyperdense "plus" area.

Bladder Exstrophy

- Bladder exstrophy is a rare developmental abnormality that is present at birth (congenital) in which the bladder and related structures are turned inside out.
- Prenatal diagnosis of bladder exstrophy is difficult and sometimes impossible, even using US. Most often, the diagnosis is made after birth with the finding of an exposed bladder.
- Fetal MRI can accurately diagnose a wide variety of urinary tract disorders and must be regarded as a valuable complementary tool to US in the assessment of the urinary system, particularly in cases of inconclusive US findings.

Bladder Fistula

Bladder fistulas are represented by the following:

- *Vesicovaginal fistulas:* These fistulas are correlated to prior gynecologic procedure, obstetrical trauma, adjacent neoplasms, and radiation therapy. Cystography is the procedure of choice to detect these fistulas.
- *Enterovesical fistulas:* These fistulas are the most frequent causes of enterovesical fistulas are sigmoid diverticulitis, colon and bladder malignancies, Crohn's disease, pelvic

radiation, trauma, and infection by actinomycosis, tuberculosis, lymphogranuloma venereum, or an adjacent abscess, such as neglected appendicitis. Indirect signs of a fistula include gas within the bladder and an irregular outline to the bladder wall. A suspected fistula is studied by cystography or barium enema. Computed tomography and MRI outline some bladder fistulas. Gadolinium-enhanced T1-weighted MR images are superior in showing a fistula compared to precontrast images. If a fistula is accessible, contrast injection into the fistula and fistulography or MRI should define it.

- *Uterovesical fistulas:* These fistulas are rare and could be related to prior cesarean sections and may manifest with vaginal urinary leakage.

Bladder, Neurogenic

- Bladder dysfunction is classified into an uninhibited neurogenic bladder, hyperreflexive detrusor (reflex neurogenic, contractile bladder), areflexic detrusor (autonomous neurogenic, flaccid bladder), and sensory or motor paralysis.
- In an uninhibited neurogenic bladder, voluntary external sphincter contraction prevents voiding during uninhibited voiding. As a result, the posterior urethra is dilated to the external sphincter level, and the imaging appearance is similar to a spinning top. These findings occur in infants with an immature bladder and adults with a cerebral cortical lesion (stroke, brain tumor). In infants, the imaging appearance tends to be similar to that seen with posterior urethral valves.
- Patients with a lesion above the lower lumbar level have detrusor hyperreflexia and develop a trabeculated thick-walled bladder. Such a hyperreflexive detrusor is found in patients with multiple sclerosis and lesions inducing spinal cord damage (trauma, tumor, syringomyelia). A large

postvoid residue is common. Bladder contractions result in bladder neck opening, but the striated external sphincter does not open and thus bladder pressure increases. Associated vesicoureteral reflux is common in these patients and, if not corrected, often results in loss of renal function. Lower motor neuron involvement leads to detrusor areflexia. These patients develop a large, thin-walled bladder. No detrusor contractions are evident with an areflexic detrusor. The bladder neck remains open, the external sphincter does not constrict normally, and these patients are incontinent.

- Additional variants of a neurogenic bladder include sensory and motor paralysis. The former is most often found in diabetics. Motor paralysis develops in some multiple sclerosis and polio patients. Urinary incontinence and retention are common problems in multiple sclerosis, often presenting a complex appearance.

Bladder Trauma

- Spontaneous bladder rupture in the absence of trauma is rare but has occurred in a setting of previous radiation therapy, surgery, and infection or is idiopathic. The risk of bladder rupture increases with bladder distention. Perforation of an empty bladder is generally associated with a penetrating injury, either extrinsic or a bone fragment. After blunt pelvic trauma or in a setting of pelvic fractures, bladder or urethral injury is suggested by hematuria or inability to urinate.
- MRI is generally precluded during the immediate post-trauma period by monitoring logistics in a strong magnetic field.
- CT is used to evaluate for pelvic and abdominal trauma. The presence of pelvic fractures and pelvic fluid is associated with bladder rupture, but a bladder perforation cannot be excluded on this study without full bladder distension.

Bone Metastases

- Bone metastases may either be osteoblastic, be osteolytic, or have mixed characteristics. Because bone scintigraphy is sensitive to bone buildup, it visualizes osteoblastic metastases very well and is also sensitive to mixed lesions.

Suggested Reading

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