

73. Urinary Bladder and Male Pelvis

Urinary bladder carcinoma is best locally staged with MRI. It is important however to note that a thickened wall (> 5 mm) is a non-specific finding seen in an underfilled bladder, acute cystitis, fibrosis, and infiltrative cancer. Pelvic and perivesical lymph nodes with > 5 mm short axis, with irregular borders and absent fatty hilum are suspicious for lymph node metastases. A large urinary bladder carcinoma is well visualized in Fig. 73.1 on (A) DWI and (B) contrast enhanced FS T1WI, with high SI on DWI (corresponding to restricted diffusion on the ADC map, not shown) and enhancement post-contrast. The moderate degree of enhancement of the bulk of the tumor (when compared to the normal bladder wall) is due to the necrotic nature of the lesion. The inset T2WI demonstrates well the extravesical tumor in perivesical fat. The abdominal wall is not invaded, thus by TNM classification this is a T3b lesion. The pre-ostial segment of the right ureter is also noted to be enlarged.

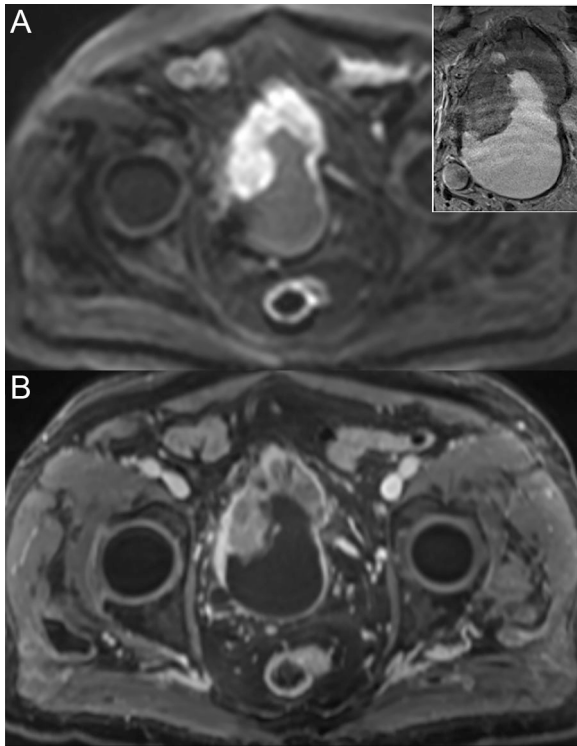


Fig. 73.1

A reduced field of view has been shown to improve image quality and may have the potential to improve the accuracy of differentiating between muscle invasive and non-muscle invasive urinary bladder cancer. Carcinoma enhances earlier and more avidly than the normal wall. Delayed (> 2 minutes) post-contrast image acquisition limits evaluation of

the bladder wall due to urinary excretion of the administered gadolinium chelate. Cystitis enhances similarly, as opposed to the late enhancement seen with wall fibrosis. Bladder carcinoma is staged by the TNM system based on whether the tumor is superficial to the muscular layer (T1), invades the layer superficially (T2a) or deeply (T2b), invades the perivesicular fat micro- (T3a) or macroscopically (T3b), or extends to adjacent organs (T4). An intact low SI muscular layer signifies a T1-T2 lesion on MR, whereas T2b and T3a lesions cannot be readily distinguished on MR.

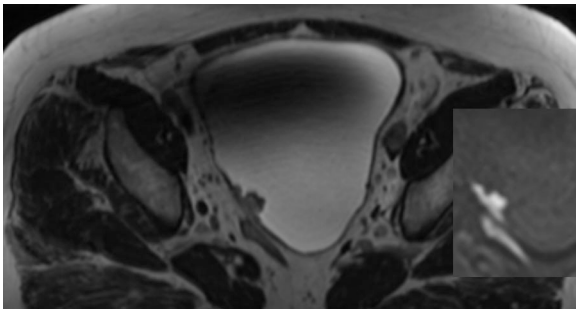
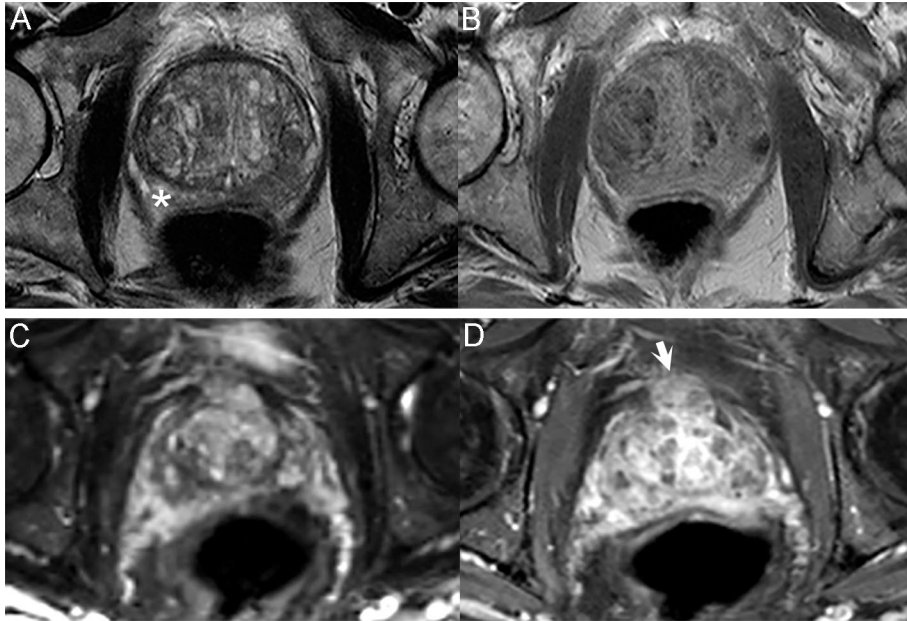


Fig. 73.2

A small TNM T2 bladder carcinoma is shown in Fig. 73.2 on T2WI, located along the right urinary bladder wall. This was seen on an exam performed for the prostate. The inset DWI image demonstrates the high SI of the lesion, which corresponded to restricted diffusion on the ADC map (not shown).

Nodal evaluation by MR is guided by size (abnormal being defined as > 10 mm for oval and > 8 mm for round nodes) with accuracy comparable to CT. Staging is based on node number and location, with a single regional lymph node metastasis in the true pelvis defining N1, multiple such defining N2 and metastasis to the common iliac lymph nodes defining N3. Detection of distant metastases to bone (M1) is best identified, due to the high SI of the metastasis, on FS or STIR T2WI. The seminal vesicles are posterosuperior to the prostate, exhibiting loss of their normal hyperintense fluid SI on T2WI if involved with cancer. Seminal vesicle cysts, associated with urogenital abnormalities, are the most common congenital abnormality of the seminal vesicles.

MR plays an evolving role in preoperative staging of prostate cancer and in assessing therapeutic response. At 1.5 T high resolution imaging necessitates use of an endorectal coil (for adequate SNR). The disadvantage of an endorectal coil (which regardless of field strength improves SNR and image quality) is that it can be uncomfortable. The need for an endorectal coil at 3 T is controversial, with prostate MR performed at many sites without such (employing only a pelvic phased-array coil). The normal prostate appears homogeneous on T1WI, the majority of the gland (i.e. the peripheral 60%) appearing



73.3

hyperintense on T2WI. Hyperintensity on T2WI correlates with predominance of fluid-filled acinar elements peripherally as opposed to smooth muscle elements in transitional and periurethral regions. Figure 73.3 A, B illustrates a case of benign prostate hypertrophy, showing a symmetrically enlarged prostate on (A) axial T2WI with nodular enlargement of the central gland. On (B) CE T1WI such regions are hypointense to the otherwise heterogeneously enhancing gland. In distinction, prostate carcinoma may manifest as a hypointense lesion in the gland's periphery on T2WI, although this guideline is less reliable for the detection of higher SI mucinous tumors. The finding of capsular and neurovascular bundle invasion is important for staging purposes and for tailoring surgical treatment. Figure 73.3 illustrates on (C) FS T2WI and (D) CE FS T1WI a case of prostate carcinoma clearly invading the capsule (white arrow) and extending to the right pelvic side wall. A useful finding denoting extracapsular extension, illustrated in this case, is loss of the normal recto prostate angle—a normal angle denoted by the asterisk in Fig. 73.3A. Other suggestive findings on T2WI include an irregular bulge of tissue beyond the low SI capsule, smooth capsular bulges, and neurovascular bundle asymmetry. Periurethral or transitional zone neoplasms are difficult to identify on T2WI. Furthermore, the classic finding of peripheral cancer on conventional MR—a hypointense peripheral lesion—is nonspecific for prostate cancer, occurring also with hemorrhage, prostatitis, and prostate atrophy or fibrosis. A number of MR techniques may be combined to more accurately identify prostate cancer. DWI is useful both in initial detection of neoplasm and in assessing tumor recurrence post-operatively. Increased cellularity of prostatic neoplasia restricts the extent

of Brownian water (proton) motion in the extracellular space, a condition manifest as high SI and low ADC values on DWI. Whole body DWI may eventually play a role in detecting distant prostatic metastases. MR spectroscopy findings of prostate cancer include increased choline + creatine to citrate ratios, although such alterations may also be seen with prostatitis or focal atrophy. Dynamic contrast enhanced MRI—commonly used in breast imaging (see Chapter 63)—can be utilized to construct pharmacokinetic models of tissue gadolinium concentration, although semi-quantitative approaches have been shown to be equally effective in identifying prostate malignancy. Enhancement patterns consistent with neoplasia include early enhancement onset, short time to peak, high levels of peak enhancement, and early washout of enhancement. The most discriminating parameter is derived from subtraction of peak enhancement values in the region of concern from that of adjacent peripheral or central glandular tissue, termed relative peak enhancement. A high relative peak enhancement is characteristic of prostate carcinoma. Compressed sensing has made this approach more viable, with resultant high temporal resolution and image quality. Illustrated in fig. 73.4 are GRASP scans (selected time points pre- and post-contrast) acquired at 3 T with a 2.2 sec temporal and a 1.1 mm spatial resolution. A suspicious lesion (arrow) in the peripheral zone with early enhancement and rapid washout is identified.

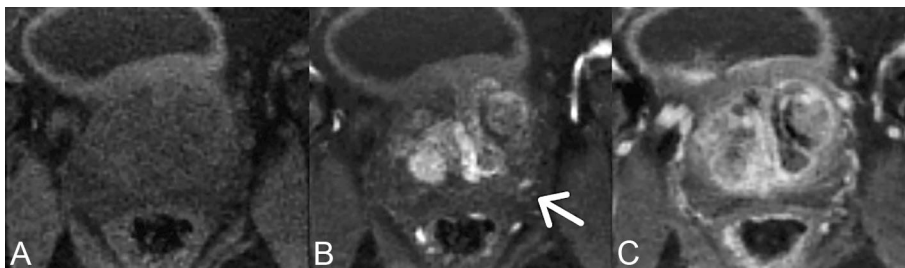


Fig. 73.4

Courtesy of Kai Tobias Block

Scrotal abnormalities are not uncommonly evaluated on MR, with positioning important when using a surface coil to assure that side-to-side differences involving the testicles reflect pathology, not simply distance from the coil. The normal testes are intermediate SI between fluid and fat SI on T1WI, slightly hypointense to fluid on T2WI, and covered by a hypointense layer of fibrous tissue—the tunica albuginea. Bilateral hydroceles are illustrated in the (A) axial T2, (B) T1, and (C) sagittal T1WI of Fig. 73.5. The testes in these images are not clearly seen, but the hydroceles demonstrate the expected SI of (A) hyperintensity on T2 and (B, C) hypointensity on T1WI. Testicular cysts are a commonly identified, fluid-like SI lesion on MR. MR characteristics of neoplastic testicular masses are dependent on tumor pathology with seminomas exhibiting homogeneous hypointensity on

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T2WI possibly with low SI fibrous bands which enhance more than the remainder of the tumor. Nonseminomatous tumors are more heterogeneous both pre- and post-contrast. Acute testicular infarctions, as seen in the setting of torsion, likewise manifest as edema-like SI, with more chronic lesions appearing as low SI scar.

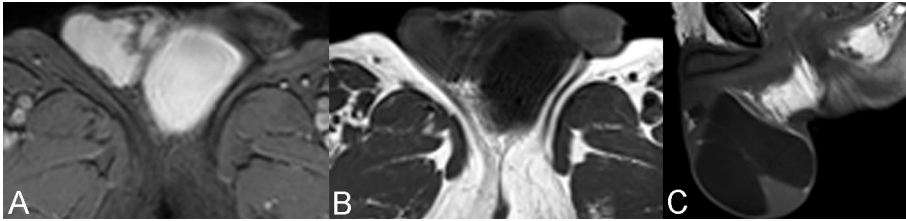


Fig. 73.5