Imaging Features of Common and Uncommon Bladder Neoplasms

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KEYWORDS

- Bladder neoplasms • Computed tomography
- Magnetic resonance imaging • Transitional cell carcinoma
- Squamous cell carcinoma

The urinary bladder is located within the extraperitoneal space, surrounded by pelvic fat. Four layers compose the bladder wall: mucosa (urothelium); a vascular submucosa (lamina propria); muscularis propria (inner and outer longitudinal smooth muscle, with an intervening circular layer); and adventitia. The peritoneum serves as a serosal covering, bolstering the bladder dome.[1–3] The bladder trigone contains an extra layer of detrusor muscle, lending it a slightly thicker appearance than the adjacent bladder wall.[2]

The urothelium is lined by layers of transitional cells, which can transform into a variety of benign and malignant tumors. Most tumors (90% to 95%) are epithelial in origin.[4] Benign entities include papillomas and adenomas. Malignant tumors are more common and include entities, such as urothelial cell carcinoma, squamous cell carcinoma, and adenocarcinoma, and rarer entities, including small cell or neuroendocrine carcinoma and carcinoid tumors.[3,5–7] Furthermore, epithelial tumors may exhibit mixed cell types, such as concomitant urothelial and squamous cell carcinoma or urothelial carcinoma and adenocarcinoma.[8]

Nonepithelial tumors, or mesenchymal tumors, include benign entities, such as leiomyoma and neurofibroma, and malignant entities, including leiomyosarcoma and lymphoma.[9]

Although there is considerable overlap in the clinical and radiologic presentation of these neoplasms, biopsy provides definitive diagnosis. However, many of these entities have specific radiologic features that may dictate clinical management.

IMAGING TECHNIQUES

Evaluation of the bladder begins with direct visualization of the mucosa using cystoscopy. However, clinical staging with cystoscopy cannot reliably determine the depth of invasion or histologic diagnosis, both critical prognostic factors. Clinical staging is inaccurate in 25% to 50% of patients with muscle invasive malignancies.[10,11] Therefore, imaging strategies using computed tomography (CT) or magnetic resonance (MR) imaging are used to complement cystoscopic examinations.

CT has become the imaging modality of choice for the evaluation of hematuria, supplanting previous strategies, including excretory urography.[12] CT urography (CTU) protocols permit the evaluation of the lower urinary tract as well as evaluate for direct perirenal, periureteral, and extravesical tumor extension, in addition to lymphadenopathy and distant metastasis.[13] The use of multidetector helical CT permits fast volumetric acquisition of

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high-resolution images in addition to multiplanar reconstruction capabilities.

CTU has a reported sensitivity and specificity of 79% and 94% respectively for bladder malignancies.[14] However, CTU is primarily useful in the evaluation of advanced stage disease. Specifically, CTU cannot determine the depth of invasion[15] or microscopic perivesical invasion.[1] Overall accuracy for local bladder cancer staging is approximately 60%, with a tendency to overstage.[3]

MR imaging has several advantages for evaluating bladder neoplasms because of its superior soft tissue resolution and direct multiplanar imaging capabilities.[16] Additionally, contrast between perivesical fat, bladder wall soft tissue, and urine permits excellent soft tissue detail, allowing improved local staging over CTU. Reported accuracy for overall staging ranges from 60% to 85%, with local staging accuracy ranging from 73% to 96%.[17]

MR imaging is performed using a pelvic phased array coil to permit high resolution for local staging.[1] Standard sequences include T2-weighted imaging (T2WI) and precontrast and postcontrast T1-weighted imaging (T1WI). T1WI images allow the depiction of the tumor, perivesical invasion, and lymph node or bone marrow involvement.[1,18] On T1WI, the bladder tumor typically has a low to intermediate signal intensity similar to that of the bladder wall.[16] With the use of gadolinium contrast, tumors involving the urothelium and submucosa demonstrate prominent enhancement compared with the uninvolved bladder wall.[19,20] T2WI allows the assessment of bladder wall invasion, or invasion into surrounding structures, such as the prostate or seminal vesicles, and uterus or cervix.[1] On T2WI, the tumors tend to be more conspicuous because they contrast with surrounding structures (because the signal intensity of tumors is typically intermediate between that of the darker bladder wall muscle and the brighter high-signal-intensity urine).[16]

Diffusion-weighted imaging is a newer MR imaging technique that evaluates thermally

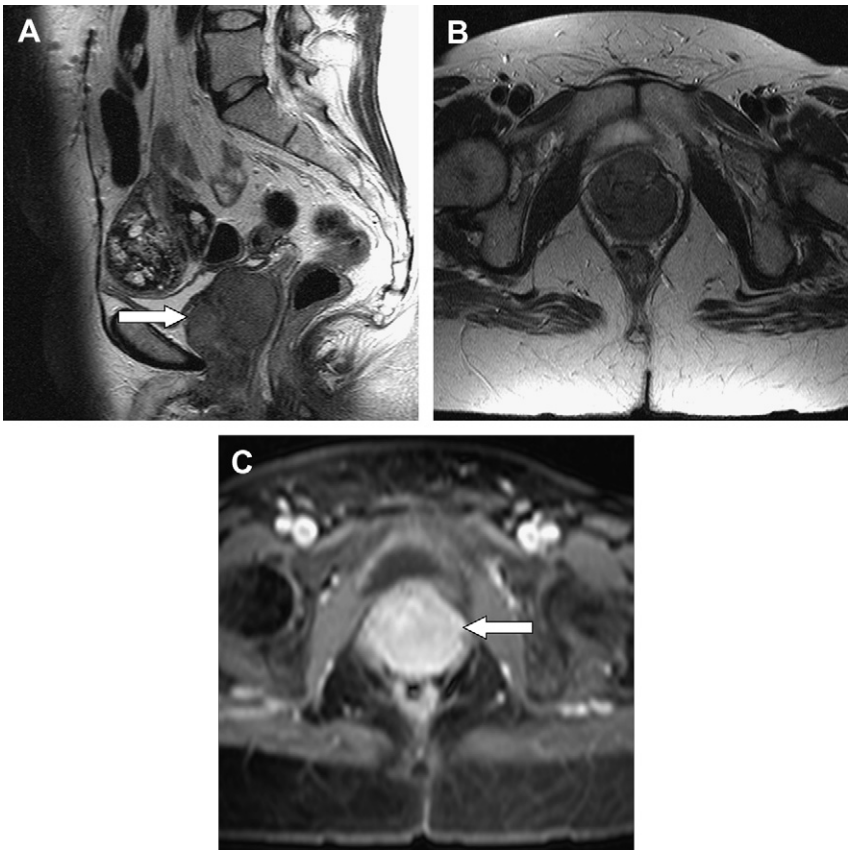

Fig. 1. Leiomyoma. Sagittal (*A*) and axial (*B*) T2WI demonstrate a smooth intramural mass (*A–arrow*) along the posterior superior bladder wall. The mass demonstrates homogenous low signal intensity. (*C*) Axial contrast-enhanced T1WI shows uniform avid enhancement (*arrow*).