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Bladder conditions: radiology, ultrasound, what else?

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CYSTOGRAPHY

The double contrast cystogram is the best radiographic test to assess the urinary bladder for filling defects (masses, mural lesions, calculi). The positive contrast cystogram can hide smaller filling defect lesions due to overlying opacity of the iodinated contrast material. It is best for assessing bladder rupture. Either can be reliably used to assess bladder wall thickness. A negative contrast cystogram is rarely used but can be helpful in diagnosing small calculi. It should not be used to assess bladder integrity, as false negative results will occur; it is much easier to detect iodinated contrast material outside the bladder than it is to detect a small amount of free abdominal air.

ULTRASOUND

The bladder wall, mucosal surface, the trigone, ureteral jets, proximal urethra, prostate gland, and surrounding pelvic and sublumbar tissues are easily assessed when the bladder contains urine. Key points in not missing subtle lesions are careful attention to overall ultrasound machine gain reduction to diminish the echogenicity of the far-field wall. If not reduced to minimal levels to allow proper visualization of the far-field bladder wall, small calculi and weak acoustic shadows will be hidden in the overly echogenic bladder wall. Echogenic artifacts positioned into the bladder lumen (side-lobe artifacts) are also common.

Cystitis

Bladder wall thickening associated with cystitis is classically most severe cranioventrally, although thickening may certainly be generalized. Wall thickness varies upon the severity of pathology and the degree of bladder distention. Non-distended bladders usually have uniform increase in thickness. In polypoid cystitis, focal areas of wall thickening will be seen in addition to generalized thickening. Polyps may have a thin stalk, others more broad-based and malignant appearing. Emphysematous cystitis can be diagnosed sonographically by visualization of highly echogenic gas within the bladder wall or in the bladder lumen usually caused gas-forming bacteria (E. coli), secondary to diabetes mellitus. The presence of gas within the bladder can be confirmed with radiography.

Cystic Calculi

Radiopaque or radiolucent calculi are imaged as echogenic foci within the dependent portion of the bladder, usually with acoustic shadowing. Size, shape and number vary from large solitary or multiple stones to one or two tiny calculi. Shadowing sediment (“sand”) may also be seen, which although gravity dependent, is easily suspended when the bladder is “bounced” with the transducer or the patient is repositioned. Occasionally with severe chronic cystitis, mural mineralization can occur, or small calculi may adhere to the bladder wall. Small calculi should be measured. Small, 1-2 mm calculi should be measured as they can pass on their own, especially in face of aggressive fluid therapy. This is a point of frustration for the surgeon who may not find calculi at surgery!

Colonic gas may mimic shadowing calculi within the bladder or “hide” smaller stones because of gas shadowing. The colon may indent the bladder wall, and its crescent-shaped hyperechoic appearance with acoustic shadowing can truly mimic a cystic calculus. It is therefore important to positively identify the colon. This is best done by visualizing the colon in cross-section as well as in a sagittal plane.

Echogenic Urine

In addition to gravity dependent echogenic urinary sediment that “settles out” during the examination, it is not uncommon to encounter echogenic, evenly “suspended particles” within the urine. In most cases this is an incidental finding and does not represent pathologic urine. In cats, suspended particles may be lipid droplets, a normal finding. Rabbits normally have extremely echogenic urine. However, particulate matter that settles out is nearly always indicative of infection, hemorrhage, crystals, or even renal casts or tubular debris. Often in the case of chronic infection or hemorrhage, echogenic urine is not uniform in distribution or shape and may acquire a more organized appearance; irregular linear strands or bizarre-shaped structures may form. They may adhere to the bladder wall and difficult to distinguish from a polyp or mass lesion in some instances. Color or power Doppler evaluation helps differentiate living from non-viable tissue.

One note of interest when regarding cystocentesis is to be certain to agitate particulate matter within the urine so as to obtain a representative sample. “Skimming off the
top" (the near field anechoic portion of the urine) may not yield a representative urinalysis. Indeed, the results will be misleading.

**Bladder Rupture**

Ultrasound can be useful in cases of bladder rupture. Free abdominal urine will be seen as anechoic areas between intra-abdominal organs. The urinary bladder may be difficult to identify in severe cases of trauma. It will be seen as linear echoic bladder wall remnants “floating” in the free abdominal fluid. In other cases, the bladder may be partially distended and the disruption of the wall may not be apparent. The “drop-out” created by edge shadowing must not be mistaken for a site bladder wall tear. Positive contrast cystography remains the standard for assessment of bladder integrity.

**Assessment of Bladder Size**

Obviously, the size of the urinary bladder varies greatly, dependent on many factors. Time intervals since urination and fluid therapy are common considerations. Pathologically, a massively distended urinary bladder may be indirect evidence of an obstruction of the bladder neck or urethra, or indicate neurological disease. Patients with hyperadrenocorticism may have markedly distended bladders, a result of excessive urine production and reduced muscle tone. Chronic massive distention can lead to functional loss of bladder wall integrity, with urine literally oozing from the bladder. This is not an uncommon finding in cats that have urinary obstruction. Conversely, a persistently small urinary bladder may indicate chronic infection, scarring, and lack of the ability to distend, a consequence of feline urologic syndrome (FUS).

**Bladder Masses**

Transitional cell carcinomas are the most common type of bladder tumors, although other types exist. Focal and irregular bladder wall thickening is usually present. These masses may be quite large, but this is one form of tumor that may be detected when it is fairly small, due to clinical signs that may occur early in the course of the disease. The trigone and proximal urethra are common sites, and extension from a prostatic neoplasm may occur. Some tumors may be seen as a more diffuse thickening of the bladder wall and be difficult to distinguish from cystitis.

Cytological or histological samples must be obtained for a definitive diagnosis. If urinalysis is not diagnostic, an ultrasound guided suction aspiration of the mass by urinary catheterization can be performed. The catheter is advanced into the bladder from the urethra and the tip is placed next to the mass and suction is applied, visualized in real-time. There is some risk of seeding of the needle tract with neoplastic cells when directly sampling urinary masses via a traditional percutaneous ultrasound guided aspiration.

**Magnetic Resonance Imaging** MRI is the standard for the assessment of micturation disease of neurogenic origin. Lower motor neuron (LMN) disorders result in an atonic bladder from detrusor and sphincter areflexia, localizing the lesion to the sacral spinal cord and/or pelvic nerves. Common LMN diseases are intervertebral disk herniation, discospondylitis, trauma to the lumbosacral region, and spinal cord tumors. Upper motor neuron (UMN) dysuria results in clinical manifestation of the automatic bladder, defined by incomplete reflex detrusor contraction, urethral sphincter spasticity and incomplete emptying of the bladder, which becomes over-distended, turgid and difficult to express. With time, overfill incontinence occurs, manifested by involuntary micturation (thus the term automatic bladder). These lesions localize more cranial in the spinal cord than LMN dysuria but the potential etiologies are the same.

**Selected References**