Implementing POCUS In the Diagnosis of Feline Lower Urinary Tract Diseases

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Introduction

Lower urinary tract (LUT) diseases in cats can present with various clinical signs, including hematuria, stranguria, pollakiuria, dysuria, and periuria.[1] Recently, it has been proposed to move away from the acronym "FLUTD" when describing cats with lower urinary tract signs (LUTS) as the term is not a true diagnosis, fails to accurately describe the underlying cause of clinical signs, and may lead to a premature diagnostic conclusion.[1] Instead, the verbiage **"lower urinary tract diseases"** is recommended, as it more accurately reflects the multiple potential causes of LUTS rather than suggesting a singular diagnosis.[1]

Point of Care Ultrasound (POCUS) of the Bladder

When presented with a feline patient exhibiting lower urinary tract signs, veterinarians have been trained to begin a systematic approach to determine the underlying cause by carefully considering the patient's signalment, lifestyle, home environment, diet, and comorbidities. Often following the physical examination, a urine sample is collected for routine urinalysis. An important step that is then often excluded following lab assessment is bladder imaging. Foregoing imaging early in the diagnostic stages can result in delayed diagnosis, incorrect diagnosis, recurrent clinical signs, unresolved disease, and frustration for both the veterinarian and care giver. The simple addition of point of care ultrasound (POCUS) to your diagnostic work-up can not only improve your accuracy of the correct diagnosis saving frustration and client funds but can also increase revenue for the practice and improve job satisfaction for the veterinary team. Additionally, referring to saved ultrasound images taken at previous visits can help assess a patient's response to treatment and aid in chronic disease monitoring.

Most disorders that affect the urinary bladder can be readily identified via ultrasound, making it the diagnostic modality of choice.[2] The patient is placed in dorsal or lateral recumbency and gently restrained using a cat friendly technique.[3] Thick bedding should be placed on the table where the patient will be placed, and the patient gently held still while being allowed to hide under a towel if desired. The room should be kept quiet with dim lighting. The more relaxed the patient is, the easier the procedure will be to perform. Clipping of fur is generally not required, however alcohol or sanitizer gel will facilitate visualization of the bladder. The probe is gently placed over the caudal abdomen.

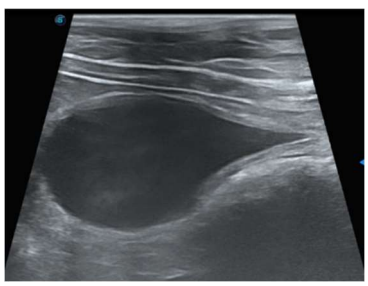
Due to its superficial location, the normal urinary bladder is easily identified as a round anechoic structure with a uniformly thin wall. Once located, the bladder should be centered on the image screen and the focal point adjusted to just dorsal to the bladder. Depth may need to be adjusted in obese or larger patients.

The bladder is evaluated for its general size, wall thickness and layering by scanning in both sagittal and transverse planes. The apex, body, and trigone are evaluated for evidence of wall thickness and symmetry. The four layers of the bladder wall include the mucosa, submucosa, muscularis and serosa may not be distinctly identified without the use of a high frequency transducer, however the overall thickness can be easily measured at approximately 1-2 mm thick (depending on the degree of distention). The ureterovesical junction may be visualized in some patients as a small focal thickening (ureteral papillae) on the dorsal bladder wall and should not be mistaken for pathology. Using color-flow doppler, jets of urine may be visualized entering the bladder from these papillae.[4]

It is important to note that the bladder cannot be adequately assessed when empty, therefore in some patients, it may be necessary to repeat the POCUS a few hours later when the bladder contains more urine. If the patient is straining or experiencing pollakiuria, a dose of analgesia such as buprenorphine may help the bladder relax and retain urine long enough to allow for improved imaging.

The contents of the urinary bladder should be examined next. It is important to note that in some clinically healthy cats, different degrees of lipiduria may be noted and appears as mild, moderate or marked hyperechoic suspended debris. Lipiduria may accumulate into clumps, but does not cause distal acoustic shadowing, reverberation or twinkle artifact[4]. In general, lipiduria is thought to be clinically insignificant and non-pathologic. Other causes of suspended debris may include blood (hematuria), white blood cells (pyuria), or crystals (crystalluria). In some cases, marked crystalluria may result in sediment on the dependent bladder wall casting a distal acoustic shadow. Gentle ballottement of the bladder, or gently rolling the patient, may help swirl up the sediment and create a “snow globe” effect.

Next, the urethra should be evaluated as it passes from the neck of the bladder into the pelvic cavity. Urine within the urethra is not typically visible, therefore if evidence of distention is present, urethral obstruction should be suspected. Finally, the area surrounding the urinary bladder is evaluated for evidence of abdominal effusion and regional lymphadenopathy.



B.

Figure 1. Normal feline bladder with (A) and without (B) evidence of lipiduria.

Specific Diseases of the Lower Urinary Tract and Bladder

Feline Idiopathic Cystitis

Feline idiopathic cystitis (FIC) remains the most common cause of feline lower urinary tract signs, representing 55-67% of cases.[1,5,6] Generally speaking, it is a diagnosis of exclusion and based on current evidence, still represents a complex systemic disorder with a lack of distinguishing signs or testing. The cause is widely accepted as a link between environmental stress, anxiety/fear, activation of the central threat response system and subsequent bladder inflammation and pain.[1,7] Often, feline patients suffering from FIC also have multiple concurrent nervous, endocrine and/or immune abnormalities present.[8] For as many as 36-61% cats, FIC is a chronic and recurrent syndrome.[7,9] especially for those cats who also experience higher levels of fear and anxiety-related problems.[7]

Irregular thickening of the bladder wall can indicate the presence of cystitis or neoplasia. In cases of cystitis, the cranioventral bladder wall is most commonly affected,[4,10] with increased wall thickness measurements of 4-6 mm. Wall thickening may be focal or diffuse. Additionally, there may be mineralization of the bladder wall and crystalluria present. It is important to note however that some mild cases of cystitis may not have any visible wall changes.

Pseudomembranous cystitis (PMC) is a rare finding of the presence of an echogenic false membrane transecting the bladder lumen and sometimes resulting in compartmentalization of the bladder. It has been found to be associated with urethral obstructions in male cats in addition to sterile and bacterial cystitis, although the underlying cause remains generally unclear.[4,11]

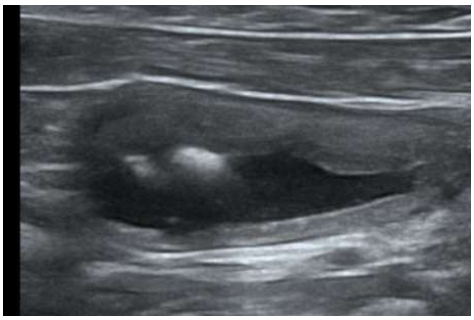


Figure 2. Ultrasound image of the urinary bladder of a cat with a diffusely thickened bladder wall, worse on the ventral aspect. The patient was diagnosed with feline interstitial cystitis (FIC).

Figure 3. Ultrasound image of the urinary bladder of a cat with pseudomembranous cystitis at the apex. There is a thin hyperechoic membrane transecting the cranial 1/3 of the bladder.

Bladder neoplasia

The urinary bladder is the second most common site of urinary tract neoplasia in cats after renal lymphoma, with urothelial carcinoma (UO), previously known as transitional cell carcinoma, the most common type of bladder neoplasia reported.[4,12] Bladder masses arise from the bladder wall and project into the lumen often in a sessile form. In a recent retrospective study, the trigone was the most common tumor location (32/118; 27.1%) however location appeared to be more variable in cats compared to dogs.[12] Other sites affected included the ventral bladder wall (28/118; 23.7%), bladder apex (20/118; 17%), dorsal bladder wall (16/118; 13.6%), multifocal or diffuse throughout the bladder (10/118; 8.5%) and lateral wall (3/118; 2.5%).[12] Many cats will have a history of lower urinary tract signs and in the mentioned study, 92 of 118 cats (78%) had been evaluated by a veterinarian for urinary tract signs before diagnosis was made.[12] Lastly, depending on the location of the tumor, the risk of ureteral or urethral obstruction is possible, therefore careful evaluation of the kidneys and ureters should be performed to evaluate for evidence of pylectasia, hydronephrosis or hydroureter.[4,13]

Diagnosis of UC is commonly obtained via trans-abdominal FNA, cystoscopic biopsy (female cats), traumatic catheterization or urinary sediment exam. Although the potential for seeding UC within the abdomen has historically been a concern following these procedures, considering the aggressive nature of the tumor with relatively poor survival times, the author feels the benefit of obtaining a prompt diagnosis (via FNA) to allow for earlier treatment may outweigh the risk of neoplastic seeding. In the Griffin 2020 study, only 4 of 118 cats developed evidence of neoplastic seeding following FNA and/or celiotomy for diagnosis.[12]

Urinary bladder lymphoma is rare in cats. The most common complications associated with urinary bladder lymphoma in one study were due to ureteral obstruction and included hydronephrosis and hydroureter.[14] Radiographic and ultrasonographic appearance of lymphoma is similar to other urinary bladder tumors, therefore it should be included in the differential diagnosis of a patient with urinary bladder wall thickening and/or mural mass.

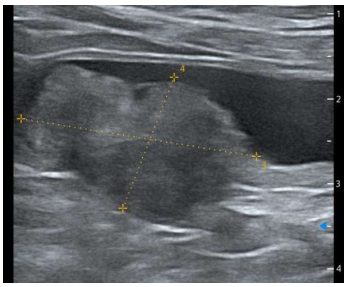


Figure 4. Ultrasound image of the urinary bladder of a cat with irregular, focal thickening of the dorsal bladder wall (between calipers). The patient was diagnosed with Urothelial Carcinoma via trans-abdominal FNA.

Calculi

Cystoliths commonly appear as hyperechoic foci on the dependent bladder wall with clean distal acoustic shadowing. Both radiolucent and radiopaque calculi are visible on ultrasound. Scanning the bladder carefully in both sagittal and transverse planes is imperative, or calculi may be missed. Additionally, care should be taken to avoid misinterpretation of the colon in transverse view for urinary calculi.[4] The author has found that putting the color flow doppler over a suspect cystolith will result in a "dazzle" effect that helps confirm the presence of mineral. If calculi are suspected, correlation with abdominal radiographs is recommended.

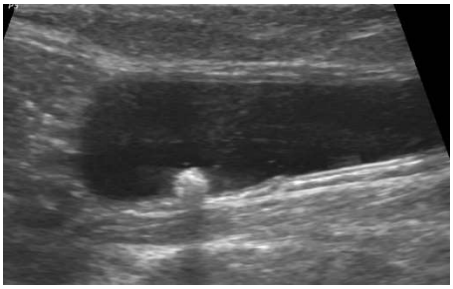


Figure 5. Ultrasound image of the urinary bladder of a cat with a round, hyperechoic foci located at the dependent part with distal acoustic shadowing. This patient was diagnosed with struvite urolithiasis.

Blood clots

Often associated with cystitis, trauma, bleeding disorders, infection, neoplasia or primary renal hematuria, blood clots are often identified within the recumbent aspect of the bladder and may appear to be suspended or floating within the lumen.[4] Blood clots are often irregular in shape and may appear to have a "tail"-like feature. They do not produce distal acoustic shadowing. Because of their heterogenous, mass-like appearance, they may be confused for neoplasia. To help distinguish a blood clot from neoplasia, changing patient position (which results in movement of the clot) and use of color-flow doppler (negative color flow in a clot) can be performed.

Ultrasound guided procedures

Cystocentesis

Cystocentesis is a routine procedure used to collect a sterile sample of urine directly from the bladder. Ultrasound guidance can be extremely useful for cases when a bladder is difficult to palpate (due to patient size) and allows for visualization of bladder anatomy at the same time. As previously discussed, the patient should be restrained using a cat friendly technique. Sedation/analgesia is generally not necessary but may be used for highly anxious, distressed or painful patients.

While one hand holds the ultrasound probe steady, the other hand holds a 22 or 23 G 1" needle attached to a 3-5 ml syringe. The needle should be aligned with the transducer and plane of the ultrasound beam and then inserted through the body wall into the bladder. The needle should be visualized at all times. Once in the lumen, the urine sample can be collected.

Complications of cystocentesis are rare but can include bruising of the ventral abdomen skin, subcutaneous hematoma formation, hemorrhage from major abdominal vessel puncture (aorta), hemorrhage into the bladder lumen, urine leakage and bladder rupture.[4] Extreme care should be taken not to inadvertently penetrate the aorta which runs just dorsal to the urinary bladder.[4]

Rarely, the cystocentesis procedure can trigger a vasovagal reaction. The reaction occurs moments after the procedure and the affected patient may vocalize, urinate, act disoriented or weak, vomit, develop bradycardia, tachypnea, ptyalism, open-mouth breathing, and/or collapse.[4,15] If this reaction occurs, supportive care with flow-by oxygen therapy and close monitoring is often all that is needed, however in some extreme cases more advanced medical intervention may be necessary.[4,15]

Fine Needle Aspirates

Percutaneous ultrasound-guided aspiration is an excellent diagnostic tool for both the upper and lower urinary tract. It is generally a safe procedure that is considered minimally invasive and may help avoid the need for more expensive diagnostics such as surgical biopsies.

Aspiration of bladder masses is the most common reason for performing this procedure on the lower urinary tract. As previously mentioned, the risk of neoplastic seeding exists anytime a needle is placed into a potential mass in the bladder wall, therefore it is imperative to discuss this procedure with caregivers and carefully consider the risk and benefit. Alternatively, ultrasound can be used to guide a urethral catheter into the bladder lumen, where samples can be taken following gentle trauma to the mass.

Summary

The use of POCUS when presented with cases of lower urinary tract disease in cats can be an important and incredibly useful part of the diagnostic work-up. Imaging should always be performed especially when signs are recurrent, or refractory to treatment. The art of imaging the lower urinary tract can easily be performed by a veterinarian or veterinary nurse and adding this diagnostic modality to practice can elevate care of the feline patient, increase revenue to the practice and improve job satisfaction.

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