

David J. Polzin, DVM, PhD, Diplomate ACVIM, University of Minnesota

Inappropriate Urination in a Dog

A 13-year-old spayed female mixed-breed dog was presented for decreased appetite, lethargy, polyuria, and voiding in inappropriate locations.

History. The signs had been occurring over the past week; in addition, the urine was foul-smelling. She had 2 previous urinary tract infections (UTIs), the first occurring when she was a young adult and the second during middle age.

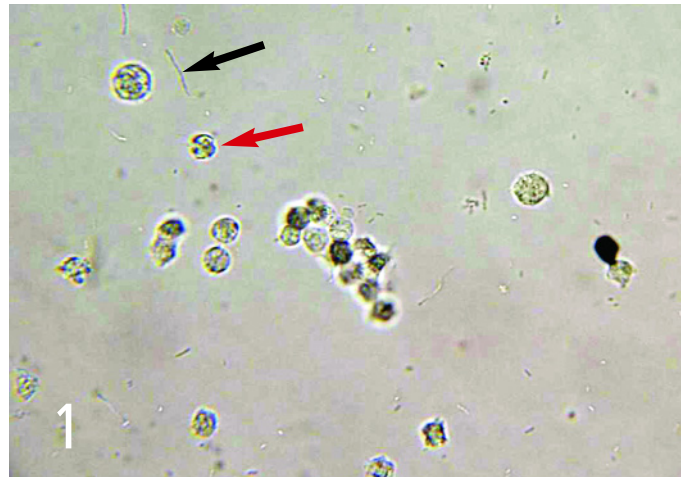
Physical Examination. Physical examination was largely unremarkable with a body condition score of 6/9. Temperature, pulse, and respiration were within normal limits; blood pressure was 124/84. Abdominal palpation elicited no discomfort. Hydration was assessed as normal.

Laboratory Diagnostics. A complete blood count showed normocytic, normochromic, hypoproliferative anemia (packed cell volume, 27%); white blood cell count and differential were normal. Serum creatinine level was 3.4 mg/dL, blood urea nitrogen level was 87 mg/dL, and serum phosphorus level was 7.9 mg/dL; results of other laboratory tests were within normal limits. Urinalysis revealed a urine specific gravity of 1.018, 1+ proteinuria, pyuria, and bacteriuria (**Figure 1**). Urine culture grew $> 10^5$ colony-forming units/mL *Escherichia coli* with wide antimicrobial susceptibility.

Imaging Studies. Radiographs showed small irregular kidneys; no uroliths were present. Renal ultrasonography revealed hyperechoic renal cortices; reduced corticomedullary differentiation; and bilateral, moderate to severe renal pelvic dilation with obliteration of the pelvic recesses (**Figure 2**). The proximal ureters did not appear dilated.

ASK YOURSELF ...

- What is the diagnosis based on the clinical signs and diagnostic results?
- What diagnostic tests would confirm the diagnosis?
- How does recognition of the diagnosis alter treatment for the urinary tract infection?



Urine sediment showing pyuria (red arrow) and bacteriuria (black arrow).



Renal ultrasonography showing hyperechoic renal cortices and moderate to severe renal pelvic dilation.

continues

CKD = chronic kidney disease; hpf = high power field; UTI = urinary tract infection

Diagnosis: Pyelonephritis

Differential Diagnosis. The clinical signs point to chronic kidney disease (CKD) and UTI. Dogs with CKD commonly develop UTI; however, differentiating pyelonephritis from lower UTI is often difficult. Renal pelvic dilation is often interpreted as pyelonephritis but may also result from polyuria. Although more commonly seen in cats, pelvic dilation and blunting of the papillae may also result from chronic partial ureteral obstruction.

Preliminary Diagnosis. A tentative diagnosis of stage 3 CKD and UTI was made. The UTI could be a cause for kidney disease (pyelonephritis) or a comorbid condition. Treatment with amoxicillin-clavulanate, 20 mg/kg divided Q 12 hours, was initiated. Because pyelonephritis was possible, 4 weeks of therapy was recommended.

Outcome. The dog's appetite and activity improved within days, and the polyuria decreased over the next 2 weeks. A repeat serum biochemical profile performed after 2 weeks of therapy showed a creatinine level of 2.4 mg/dL, a blood urea nitrogen level of 39 mg/dL, and a phosphorus level of 5 mg/dL. Urine specific gravity was 1.026, and urine sediment was inactive. A urine culture showed no growth.

Three weeks later (1 week after completing therapy), serum creatinine level was 2.1 mg/dL and blood urea nitrogen level was 36 mg/dL, respectively. Urine specific gravity was 1.021, and microscopy showed 1 to 3 WBC/hpf. Most important, urine culture revealed $> 10^3$ colony-forming units/mL *E coli*. The antibiotogram is shown in the **Table**.

Early recurrence of the same organism suggests relapsing UTI. However, a recent study in cats with CKD and UTI indicates that finding the same species and antibiotogram alone may be unreliable in confirming relapse.

Further Diagnostics. Relapsing UTI may result from drug failure (wrong drug, dosage, or duration of therapy, or lack of owner compliance),

Table. Antibiotogram for *Escherichia coli* infection

Amikacin	Sensitive
Amoxicillin-clavulanic acid	Sensitive
Ampicillin	Sensitive
Cefazolin	Sensitive
Ceftiofur	Sensitive
Cephalothin	Sensitive
Enrofloxacin	Sensitive
Erythromycin	Resistant
Gentamicin	Sensitive
Marbofloxacin	Sensitive
Orbifloxacin	Sensitive
Tetracycline	Sensitive

failure to eliminate uroliths, or failure of the antibiotic to achieve adequate therapeutic concentrations at site of infection. In females and castrated males, the kidneys are the most likely site of any existing infection, whereas the prostate is the likely site of infection in intact males.

To confirm renal involvement in this case, urine was obtained from the renal pelvis by ultrasonography-guided pyelocentesis. The sample

was positive for *E coli*, confirming the diagnosis of pyelonephritis.

Confirming a diagnosis of pyelonephritis is often difficult; diagnosis is often presumptive. Imaging studies may support a diagnosis of pyelonephritis, or they may be normal. A positive urine culture from renal pelvic urine or renal tissue localizes infection to the kidneys; however, treatment is often based on a presumptive diagnosis.

Treatment & Outcome. Treatment was initiated with 5 mg/kg enrofloxacin Q 12 H for 4 weeks. Effectiveness of therapy was confirmed by urine cultures obtained at 1, 4, 8, 12, and 24 weeks after completing treatment. None of the cultures showed growth.

Successful treatment of pyelonephritis requires achieving adequate urine, blood, and renal tissue antibiotic concentrations. Fluoroquinolone antibiotics are generally preferred because they reach relatively high renal tissue and urine concentrations. In experimental studies, renal concentrations of fluoroquinolones were increased with pyelonephritis, while concentrations of beta-lactam antibiotics were reduced. ■

See Aids & Resources, back page, for references, contacts, and appendices.
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DID YOU ANSWER...

- Pyelonephritis. This disease is most obvious when acute, with patients typically presenting with fever, neutrophilia, paralumbar pain, and systemic signs of illness. However, chronic pyelonephritis may be much more subtle, presenting with such findings as dilute urine, clinical signs of urgency, and relapsing urinary tract infections.
- Confirming a diagnosis of pyelonephritis is difficult, and often the diagnosis remains presumptive. Imaging studies may support the diagnosis but by themselves are not confirmatory. Additional studies must be performed to confirm that bacterial infection is present in the kidneys or renal pelvic urine. Before undertaking additional tests, clinicians should consider the balance between the risks of sample collection and the benefits of a confirmed diagnosis.
- Drugs selected for treating pyelonephritis must achieve adequate blood and renal tissue levels in addition to adequate urine concentrations. Fluoroquinolones and trimethoprim-sulfamethoxazole are more likely than beta-lactam drugs to achieve adequate concentrations in renal tissue. Duration of therapy is often extended to 4 weeks or longer, although firm data are not available to substantiate the need for these prolonged treatment schedules.

CKD = chronic kidney disease; UTI = urinary tract infection; WBC/hpf = white blood cells per high power field