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UROLOGY

Diagnosing and Managing Feline Lower Urinary Tract Disease

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Feline lower urinary tract disease (FLUTD) is a general term used to describe conditions affecting the bladder or urethra of cats;[1] it is not a syndrome or specific diagnosis. It has been reported that between 4.5% and 8% of cats presenting to veterinary practices or teaching hospitals have FLUTD.[2,3] Causes of FLUTD include physical conditions and behavioral disorders resulting in inappropriate urination (**BOX 1**). Because FLUTD encompasses a set of diseases manifesting similar clinical signs, an individualized, thorough diagnostic approach is required to determine the cause and optimize therapy (**FIGURE 1**).

CLINICAL PRESENTATION

Clinical Signs

Lower urinary tract disease can be nonobstructive or obstructive (**FIGURE 2**). Common clinical signs of each are listed in **TABLE 1**. Affected cats may exhibit one or more of these signs. Clinical signs of urethral obstruction vary with the duration of obstruction. Because of urethral diameter, obstruction is more common in male cats.[4]

Signalment

Most cats presenting with FLUTD are between 1 and 10 years of age.[4] In cats younger than 10 years, feline idiopathic cystitis (FIC) is the most common cause (55% to 63%), followed by urolithiasis (15% to 22%) and urethral plugs (10% to 21%). Neoplasia (less than 1% to 2%) and urinary tract infection (UTI; less than 1% to 8%) are uncommon.[5-7] In one study, cats aged 10 years or older were reported to have an increased risk for UTI.[3] Additionally, cats with certain metabolic disorders,[8,9] urolithiasis,[10] and prior urinary tract procedures (e.g., urethral catheterization, perineal urethrostomy)[11-13] have an increased incidence of UTI. Bladder neoplasia is rare in cats but is more common in cats older than 10 years.[3] Certain breeds may have an increased risk of specific etiologies of FLUTD; for example, in some studies, Russian Blue, Himalayan, and Persian breeds have had an increased risk of urolithiasis.[3,14]

A COMPLETE APPROACH
Treatment of FLUTD will depend on the underlying cause; successfully managing it requires a long-term commitment and a multimodal strategy.

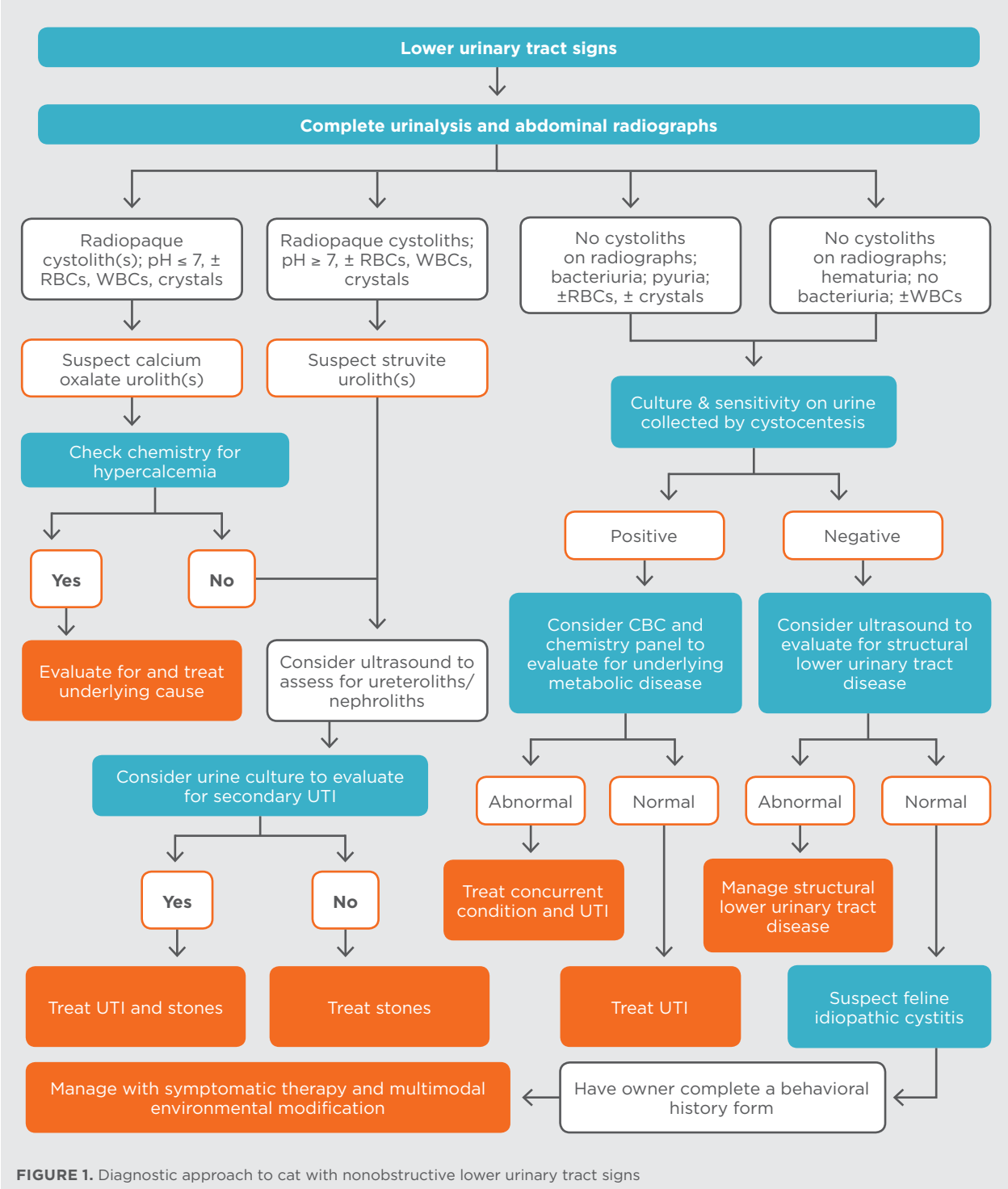

FIGURE 1. Diagnostic approach to cat with nonobstructive lower urinary tract signs

Patient History

Clinical signs help localize the problem to the lower urinary tract. Information from the client can be used to determine the duration and severity of signs. Additionally, it is important to determine if the cat is showing systemic signs of illness, especially if urethral obstruction is a concern. Information regarding the cat's environment, including diet, litterbox management, access to the outdoors, other pets in the household, available enrichment, and potential stressors, may be helpful when modifying environmental conditions as part of chronic

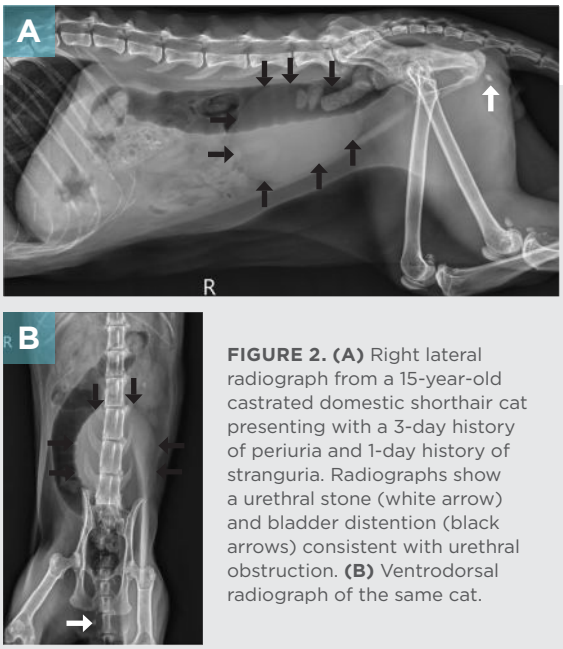

FIGURE 2. (A) Right lateral radiograph from a 15-year-old castrated domestic shorthair cat presenting with a 3-day history of periuria and 1-day history of stranguria. Radiographs show a urethral stone (white arrow) and bladder distention (black arrows) consistent with urethral obstruction. **(B)** Ventrodorsal radiograph of the same cat.

BOX 1 Etiologies of Feline Lower Urinary Tract Disease

- Feline idiopathic cystitis
- Urolithiasis
- Urethral plugs
- Urinary tract infection
- Neoplasia
- Congenital anatomical defects (e.g., urethral stricture, urachal remnant)
- Trauma
- Neurologic disorders (e.g., reflex dyssynergia)
- Behavioral disorders

management of FIC.[4] Available online surveys, such as the one included in the 2014 AAFP and ISFM Guidelines for Diagnosing and Solving House-Soiling Behavior in Cats (catvets.com/guidelines/practice-guidelines/house-soiling), can be helpful in obtaining a detailed environmental history. If the cat has been medicated, particularly with empirical antibiotics, response to therapy should be interpreted with caution because FIC typically spontaneously resolves after 1 to 7 days,[4] which may be mistaken for a therapeutic response.

Physical Examination

A thorough physical examination should be performed, including measurement of vital parameters, as urethral obstruction can result in severe metabolic derangements. A distended, painful bladder that cannot be expressed is the classic finding with urethral obstruction. The penis may be reddened from self-trauma. Patients with nonobstructive FLUTD often have a small or minimally distended bladder that may have a palpably thickened wall.[4] It is rare to palpate a mass effect in a cat with bladder neoplasia.[15]

DIAGNOSTIC PROCESS

At a minimum, a complete urinalysis, including sediment examination, and survey abdominal radiography should be performed for all cats with signs of FLUTD (**FIGURE 1**). For an adult cat younger than 10 years with acute signs, FIC and urolithiasis are the primary differentials, so urinalysis and radiography are typically adequate. If the cat is 10 years of age or older at presentation, additional differentials include UTI or neoplasia, so a quantitative urine culture is indicated and abdominal ultrasonography should be considered.

TABLE 1 Clinical Signs of Feline Lower Urinary Tract Disease

NONOBSTRUCTIVE	OBSTRUCTIVE
Pollakiuria	Stranguria
Hematuria	Anuria
Stranguria	Lethargy
Periuria (urinating in inappropriate places)	Vomiting
Licking at urethral opening	Depressed mentation
	Licking at urethral opening
	Inappetence

BOX 2 Identified Risk Factors for Feline UTIs

- Specific metabolic disorder (chronic kidney disease, diabetes mellitus, hyperthyroidism)[8,9]
- Female sex[5]
- Urolithiasis[10]
- Incontinence[13]
- Transurethral or urogenital procedure (e.g., urinary tract catheterization, perineal urethrostomy)[11–13]
- Bladder neoplasia[15]

If a cat has frequently recurring or chronic, persistent signs, differentials should include FIC, urolithiasis, UTI, and behavioral problems, so a complete diagnostic evaluation is indicated, even if the patient is not an older cat.[4]

Complete Urinalysis

A complete urinalysis includes evaluation of a dipstick, urine specific gravity (USG) measurement by refractometer, and a urine sediment examination. Urine should be analyzed within 60 minutes of collection for the most reliable results.[16] One concern is that crystals may form in vitro.[16] The leukocyte esterase test pad on the dipstick has a high false-positive rate in cats and, therefore, is not useful.[17]

Inflammatory diseases of the lower urinary tract often result in gross or microscopic hematuria, proteinuria, and possibly pyuria. Bacteriuria should prompt submission of a sample for quantitative urine culture, as debris can be easily mistaken for bacteria.[17] Urease-producing bacteria (e.g., *Staphylococcus* spp, *Proteus* spp) may result in an alkaline pH; however, a single pH measurement should be interpreted with caution as pH may vary throughout the day.

In general, struvite (i.e., magnesium ammonium phosphate) stones are associated with an alkaline to neutral urine pH and calcium oxalate stones are associated with an acidic to neutral pH.[18] Struvite crystals and calcium oxalate crystals may be present with or without urolithiasis. Struvite or calcium oxalate crystalluria does not predict which cats will form stones, can occur in apparently healthy cats, and does not require treatment if the cat has never formed stones previously.[17] Additionally, crystal type does not necessarily predict urolith composition. Although rare, urate crystals should prompt evaluation for a portosystemic shunt.[18]

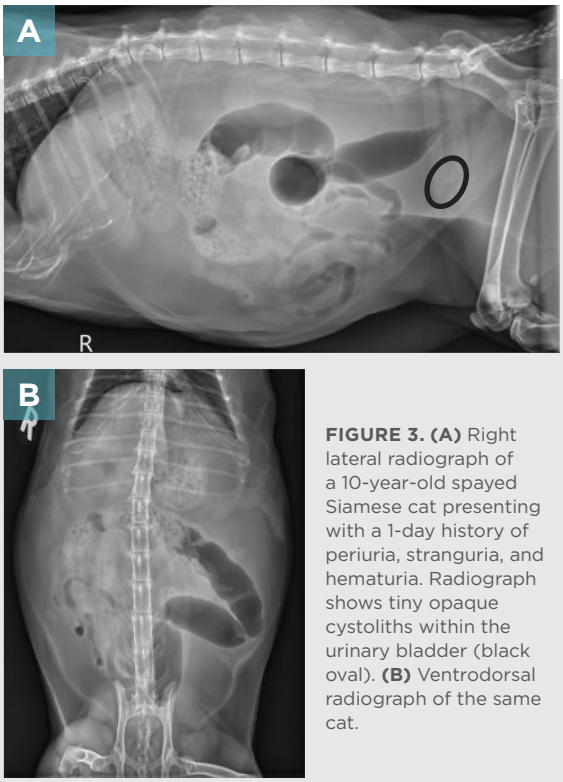

FIGURE 3. (A) Right lateral radiograph of a 10-year-old spayed Siamese cat presenting with a 1-day history of periuria, stranguria, and hematuria. Radiograph shows tiny opaque cystoliths within the urinary bladder (black oval). **(B)** Ventrodorsal radiograph of the same cat.

Abdominal Radiography

Uroliths are the cause of lower urinary tract signs in approximately 15% to 20% of feline patients,[5-7] so survey abdominal radiographs are indicated in all cats with lower urinary tract signs, regardless of patient signalment. Also, uroliths must be ruled out before FIC can be diagnosed. Struvite and calcium oxalate stones are radiopaque, and radiographs allow assessment of their presence, location, number, and size (**FIGURE 3**). Bladder neoplasia is not usually apparent on radiographs, but if a calcified mass is present, it may be detectable.

Quantitative Urine Culture and Susceptibility Testing

Urine for culture must be collected by cystocentesis. Because UTIs are a relatively uncommon cause of FLUTD in young adult cats, the decision of whether to culture may be based on factors such as

owner finances and the need to have the cat return for repeat urine collection if signs persist. A urine culture is indicated before concluding a patient has FIC, since this is a diagnosis of exclusion.

Urine culture and susceptibility testing are indicated if pyuria and bacteriuria are present on urinalysis to confirm the diagnosis and guide therapy. Studies have identified other risk factors for feline UTIs (**BOX 2**); if the patient has one of these risk factors, urine culture is warranted.

Complementary Diagnostic Tests

Complete Blood Count and Biochemistry Panel

In a patient with urethral obstruction, a biochemistry panel can detect azotemia, electrolyte abnormalities, and acid-base disturbances, which guide emergency management. In nonobstructed patients, a complete blood count and biochemistry profile can be helpful to assess for comorbid conditions (e.g., pyelonephritis). Metabolic diseases that may increase the risk of UTI (**BOX 2**) can be excluded. Patients with calcium oxalate uroliths should be evaluated for hypercalcemia.[1]

Cytology

Cytology of samples from the bladder wall can be used to diagnose certain neoplasms. Urine sediment examination may reveal urothelial cells, but these should be interpreted with caution.[15] Histopathology of bladder biopsy samples may be required to make a definitive diagnosis of neoplasia.

Imaging

Although it does not allow evaluation of the distal urethra, abdominal ultrasonography may be used concurrently with radiography to assess the size and number of uroliths. It may also show anatomic abnormalities such as a thickened bladder wall, urachal remnant, or bladder mass.

Contrast urethrography is the best imaging method to evaluate for urethroliths. For a cat with chronic, persistent lower urinary tract signs, contrast cystourethrography can be helpful to rule out small stones before concluding the patient has FIC. Other imaging modalities are rarely required.

Cystoscopy may be performed at some referral centers. The procedure can be performed on a female cat using a 1.9-mm rigid cystoscope with a 10-French sheath. Cystoscopy for male cats is limited by the small diameter of the urethra. Endoscopy provides visualization only (without sample collection). Alternative options are to perform cystoscopy after perineal urethrostomy in a male cat or to obtain antegrade access via the urinary bladder intraoperatively.[19] During cystourethroscopy, mass lesions, uroliths, certain anatomic abnormalities, and submucosal petechial hemorrhages (as seen with FIC) may be identified.[19]

In general, struvite (i.e., magnesium ammonium phosphate) stones are associated with an alkaline to neutral urine pH and calcium oxalate stones are associated with an acidic to neutral pH.[18]

SPECIFIC ETIOLOGIES

Uroliths

Uroliths are present in approximately 15% to 20% of cats with FLUTD.[5-7] The pathophysiology of urolith formation is incompletely understood. The 2 most common stone types are struvite and calcium oxalate, each accounting for greater than or equal to 40% of feline uroliths.[14,20,21] Struvite uroliths are most common in cats younger than 7 years,[1] and calcium oxalate stones are most common in middle-aged to older cats.[14,22,23] Uroliths can be present with or without crystalluria. Acute treatment involves removing or dissolving the stone(s), and chronic management is aimed at reducing the risk of recurrence.

Struvite

Struvite uroliths are commonly moderately radiopaque and associated with neutral to alkaline urine.[18] Unlike in dogs, most feline struvite uroliths form

BOX 3 Procedure for Voiding Urohydropropulsion[24]

1. Consider for female cat with cystoliths <3–5 mm in diameter (not for male cats owing to risk of obstruction)
2. Perform with cat under general anesthesia
3. Catheterize urinary bladder
4. Fill bladder with saline and remove urinary catheter
5. Position cat vertically with bowl below to catch bladder contents
6. Agitate and palpate bladder to increase intravesicular pressure and maintain a strong urine stream
7. Repeat as needed until no further calculi are passed
8. Confirm stone removal via abdominal radiographs
9. Submit stones for quantitative analysis

in sterile urine. Struvite uroliths may be treated via surgical removal, voiding urohydropropulsion (**BOX 3**), or dissolution by medical management (**BOX 4**).[1,18] Current recommendations are to attempt medical dissolution as first-line therapy unless there is a direct contraindication (e.g., dietary intolerance, urinary tract obstruction), since it is highly effective and avoids the risks of anesthesia and surgery.[18] Medical dissolution of struvite stones requires feeding a canned diet that is formulated to avoid excessive magnesium and phosphorus and to maintain an acidic urine pH.[1] Sterile struvite bladder stones usually dissolve in less than 5 weeks.[18]

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Calcium Oxalate

Calcium oxalate stones are radiopaque and are typically associated with neutral to acidic urine.[18] These stones cannot be dissolved medically and require removal by voiding urohydropropulsion or surgery. Postoperative abdominal radiographs should be taken to ensure that all calculi are removed; incomplete removal has been reported in up to 20% of cats.[25] An alternative method of removal for stones that are too large to pass through the urethra is percutaneous cystolithotomy, a minimally invasive procedure in which a cystoscope is passed into the bladder through a 1-cm surgical incision.[18,26] All removed stones should be submitted for quantitative analysis, which is used to guide management to prevent recurrence. Cats with calcium oxalate stones should be evaluated for hypercalcemia, as this is a risk factor for calcium oxalate urolithiasis.[1]

Long-Term Management

Cats that have formed a struvite or calcium oxalate stone are at an increased risk for recurrence, so long-term management and monitoring is warranted.[18] However, the cause of calcium oxalate urolith formation in most cats remains largely unknown, making preventive recommendations difficult.[1] Diets designed to prevent stone recurrence focus on decreasing concentrations of urinary solutes and crystal promotors and increasing stone inhibitors[27] (**TABLE 2**). A diet can also help achieve urine pH targets.[27]

Increased water intake is the cornerstone of preventing urolithiasis by promoting dilute urine (target USG <1.030) and increased frequency of urination to decrease urine retention time and thus time for crystal formation.[18,27] Increased water intake may be achieved by feeding a canned diet or adding water (1 cup per cup of kibble) to dry food before feeding.[27] Feeding 2 to 3 meals a day (versus a single meal) may also promote increased water intake.[1] Other strategies to increase water intake include using a water fountain, special bowls, or running faucets.[1] However, the benefit of these strategies is unproven.[28]

Urinary Tract Infection

UTI should be suspected if pyuria and/or bacteriuria are present on urinalysis, but a quantitative culture of urine collected by cystocentesis is required to confirm the diagnosis.[13] Infections are usually the result of ascending bacteria, and *Escherichia coli* is the most common causative agent.[27] The

incidence of UTI in cats with FLUTD varies between studies, apparently related to geographic location, age of the cat, and comorbidities.[1] Risk factors for UTI are listed in **BOX 2**.

Culture and susceptibility testing should be used to guide antimicrobial therapy. If the bacteria are widely susceptible and the infection is not complicated by concurrent conditions, treatment with oral amoxicillin (11 to 15 mg/kg PO q8 to 12h) for 7 to 14 days is recommended.[29] A shorter course of antimicrobial therapy (3 to 5 days) has been recommended, but research to support this in cats is limited.[30] If an underlying condition is identified (e.g., uroliths, congenital anomaly), it should be corrected, if possible.

Neoplasia

Feline lower urinary tract neoplasia is very uncommon. The most common type is urothelial cell carcinoma (UCC, formerly called transitional cell carcinoma).[15] The median age of cats presenting with lower urinary tract neoplasia is 10 to 15 years, which is substantially older than cats with FIC.[15] However, lymphoma can occur in cats as young as 1 year of age.[15] Lower urinary tract neoplasia is diagnosed using ultrasonography or contrast cystourethography paired with cytology or histopathology. Median survival time for cats treated with surgery, chemotherapy, nonsteroidal anti-inflammatory drugs, or a combination of these modalities is approximately 8.5 to 12 months.[15]

BOX 4 Approach to Medical Dissolution of Struvite Cystoliths[1,18]

- Transition cat to a canned calculolytic diet over a 7-day period
- Most feline struvite uroliths are sterile, but if a UTI is confirmed, treat with an appropriate antibiotic for the duration of the dissolution protocol
- Reevaluate at 2-week intervals with urinalyses and abdominal radiographs
  - Targets: urine pH <6.5 and USG <1.030
- Continue medical management for 1 month beyond medical dissolution of stones
- If stones have not reduced significantly in size at 1-month recheck, consider whether owner is complying with exclusively feeding calculolytic diet versus if stone composition is not struvite

Feline Idiopathic Cystitis

FIC has also been called feline interstitial cystitis, idiopathic FLUTD, feline urologic syndrome, and Pandora syndrome.[4] The most common age at initial presentation is 2 to 7 years.[3] Cats with FIC typically present with acute signs of lower urinary tract inflammation that resolve spontaneously after 4 to 7 days (80% to 90% of cases).[1] There is no single diagnostic test to confirm FIC, and diagnosis is based on exclusion of other etiologies for FLUTD.

FIC may have variable presentations, including urethral obstruction (15% to 20% of cases; more common in

TABLE 2 Approach to Prevention of Feline Struvite and Calcium Oxalate Uroliths[1,18]

	STRUVITE UROLITHS	CALCIUM OXALATE UROLITHS[a]
General	▪ Over 7 days, transition to a canned therapeutic diet formulated to prevent urolith recurrence ▪ Consider implementing strategies to encourage water intake	
Targets	▪ No struvite crystals ▪ pH <6.5 ▪ USG <1.030	▪ No or few calcium oxalate crystals ▪ pH >6.2 ▪ USG <1.030
Monitoring	▪ Evaluate urinalysis after 1 month and then every 3 months ▪ Perform abdominal radiographs every 3–6 months or if cat exhibits lower urinary tract signs	▪ Perform abdominal radiographs every 3–6 months or if cat exhibits lower urinary tract signs
Adjustments	Add oral urine acidifiers (methionine or ammonium chloride) only if average urine pH >6.5	▪ If urine is persistently acidic, add oral potassium citrate (50–75 mg/kg PO q12h) ▪ If repeated calcium oxalate urolith formation occurs, add oral hydrochlorothiazide (1–2 mg/kg PO q12h); do not use in cats with hypercalcemia

[a]*In cats without systemic hypercalcemia.*

male cats[20]), frequently recurring episodes (2% to 15% of cases), or chronic persistent signs (2% to 15% of cases).[4] In some cats, FIC is associated with comorbidities, such as gastrointestinal or respiratory tract signs.[4] Furthermore, spontaneous resolution of clinical signs may be mistaken for response to empirical therapy (e.g., treatment with antibiotics). All of these factors may lead to misdiagnosis.

Urethral obstruction is often due to urethral plugs or classified as idiopathic. Urethral plugs consist of a matrix (mucoprotein and inflammatory debris) and aggregates of crystals (predominantly struvite).[20] Acute management involves stabilizing the patient and alleviating urethral obstruction (**BOX 5**). Following discharge from the hospital, management for FIC should be implemented.

BOX 5 Approach to the Feline Patient With Urethral Obstruction[31]

1. Diagnostics and management are performed simultaneously
2. Diagnostics often include:
   - Packed cell volume/total solids
   - Biochemistry panel with electrolytes
   - Electrocardiogram
   - Urinalysis
   - Survey abdominal radiographs including the perineal region
3. Patient stabilization may include:
   - Administration of intravenous crystalloid fluids
   - Additional management of hyperkalemia with intravenous dextrose and insulin or intravenous calcium gluconate
   - Therapeutic cystocentesis
4. Relief of urethral obstruction includes:
   - Providing analgesia, sedation, and/or anesthesia
   - Sterile placement of a rigid urinary catheter into the urethra using hydropulsion to alleviate any obstruction
   - Sterile placement of an indwelling urinary catheter with a closed collection system
5. In-hospital care includes:
   - Urethral catheter care
   - Monitoring for postobstructive diuresis
   - Administering intravenous fluids, analgesia, and urethral relaxants
5. Additional recommendations are based on the cause of the obstruction
   - Cats with obstruction due to a urethral plug or that is idiopathic are managed according to the guidelines for cats with FIC.
   - Cats with uroliths require a procedure to remove the stone and medical management to prevent recurrence.
   - Consider urine culture to evaluate for UTI secondary to urinary catheter placement.

Etiology

The etiology of FIC is complex and incompletely understood, but it appears to involve a complex interaction between the urinary bladder, nervous system, adrenal glands, and environmental conditions.[4] Affected cats seem to have an excitatory sympathetic nervous system response with decreased adrenocortical function in response to stressful episodes and an associated increase in bladder wall permeability.[4,32] Various studies have evaluated risk factors for FIC, which often include being middle-aged (average, 4 to 7 years), neutered, sedentary, and overweight.[4] Environmental or behavioral risk factors, such as living indoors or living with another cat with which there is conflict, have also been recognized.[33,34]

Management

The goals of managing FIC are to decrease the severity of clinical signs and increase the interval between episodes.[1] It is important to help owners understand known predisposing factors and develop strategies to alleviate them.[1] Multiple modalities are commonly used to manage FIC, including medications to provide analgesia and to decrease urethral spasm, dietary management, and environmental management (**BOX 6**) to meet the individual cat's needs.

Episodes of acute pain are managed with buprenorphine (0.01 mg/kg transmucosally q8h to 12h).[4] An alpha antagonist (such as prazosin 0.25 to 1 mg/cat PO q8h to 12h)[31] is given to decrease urethral spasm, particularly after alleviating urethral obstruction. Feeding recommendations are to gradually transition to a moist food (greater than 60% moisture) and to use additional strategies to increase water intake.[4] A randomized, controlled clinical trial showed that feeding a urinary diet enriched with omega-3 fatty acids and antioxidants decreased the rate of recurrent episodes of FIC signs in cats.[37]

Other suggested therapies for FIC have been shown to be ineffective or have been inadequately evaluated. Antibiotics should not be administered unless a urine culture by cystocentesis is positive.[1] In cats with FIC,

an anti-inflammatory dose of prednisolone given for 10 days did not reduce clinical signs compared with placebo.[38] There is insufficient evidence to recommend short-term treatment with amitriptyline, although long-term treatment has not been evaluated.[1] There is also insufficient evidence to support the use of glucosamine.[1] Feline facial pheromones may be considered for cats with signs of stress or if signs persist after implementation of multimodal environmental modification (MEMO).[1] Cats with FIC that were given a single treatment of lactated Ringer's solution subcutaneously did not show improvement, but other subcutaneous fluid protocols have not been evaluated.[1] For any therapy, the potential benefit should be weighed against the potential for the treatment to be stressful to the cat suffering from FIC.

CONCLUSION

Lower urinary tract signs in cats may be due to several etiologies that are typically indistinguishable without further diagnostic testing. In an individual cat, there may be a single cause or multiple concurrent disorders, so a thorough and systematic approach is warranted. Diagnostic evaluation for an individual may include

BOX 6 Multimodal Environmental Modification for Cats with FIC

The American Association of Feline Practitioners and the International Society of Feline Medicine have described the 5 pillars of a healthy feline environment that support a cat's physical health, emotional wellbeing, and interactions with humans and other animals in its environment:[35]

1. Provide a safe place
2. Provide multiple, separated key environmental resources (food, water, toileting areas, scratching areas, play areas, rest areas)
3. Provide opportunities for prey and predatory behavior
4. Provide positive, consistent, and predictable human-cat social interaction
5. Provide an environment that respects the importance of the cat's sense of smell

Fulfilling these environmental needs is fundamental to preventing or correcting house-soiling behavior.[35] Adaptations to meet them are known as multimodal environmental modification (MEMO)[36] (**TABLE A**). Environmental enrichment and stress reduction are key to the management of cats with FIC. A prospective observational study evaluating the effects of MEMO in cats with FIC showed that there were significant reductions in lower urinary tract signs, fearfulness, and nervousness after 10 months.[36]

TABLE A Selected Strategies Used in Multimodal Environmental Modification (MEMO)[35]

ENVIRONMENTAL COMPONENT	STRATEGIES
Social interactions	▪ Limit ability of indoor cat to see outdoor cats ▪ Provide a safe place for cat to avoid stressful interactions (e.g., with dog, child, or other cat) ▪ Keep interactions with the cat as predictable and consistent as possible
Physical resources	▪ Provide distinct areas for sleeping, feeding, and elimination ▪ Provide comfortable sites to rest, hide, climb, and perch (multiple areas if there are multiple cats in the home) ▪ Evaluate cat's preferences for toys ▪ Provide access to a window to look through
Nutrition	▪ Hide food in various locations or provide food in a puzzle feeder ▪ Provide multiple feeding stations out of sight from one another if there are multiple cats in the home ▪ Feed away from machinery that may be startling ▪ Allow free access to fresh water ▪ Investigate individual cat's preferences (e.g., running water, bottled water)
Elimination	▪ Ensure litterbox is at least 1.5 times the length of the cat to permit digging, posturing, and covering behaviors ▪ Provide multiple litterboxes that are out of sight of one another ▪ Position litterbox away from disruptive noises ▪ Consider individual cat preferences ▪ Practice excellent litterbox hygiene
Body care and activity	▪ Provide sites for appropriate scratching behavior ▪ Consider individual preferences (substrates, surface position) ▪ Provide permitted materials to chew (e.g., cat grass, live catnip) ▪ Rotate a variety of toys ▪ Consider providing a treat after play to parallel a successful hunt

urinalysis, diagnostic imaging, and urine culture. If no cause is found after thorough evaluation, a diagnosis of FIC is made.[1] TVP

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CONTINUING EDUCATION

Diagnosing and Managing Feline Lower Urinary Tract Disease

LEARNING OBJECTIVES

1. Develop a diagnostic plan for a cat presenting with signs of feline lower urinary tract disease
2. Diagnose and manage common causes of feline lower urinary tract disease
3. Understand how to implement multimodal environmental enrichment in the household of a cat with feline idiopathic cystitis

TOPIC OVERVIEW

This article provides an overview of the clinical signs, diagnostic approach, and management of the feline patient with lower urinary tract disease.

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1. **Which clinical sign is not typically associated with feline lower urinary tract disease?**
   a. Polyuria
   b. Pollakiuria
   c. Stranguria
   d. Hematuria

2. **Which of the following imaging modalities is best to rule out a urethral stone as a cause for chronic persistent feline lower urinary tract signs?**
   a. Survey radiography
   b. Contrast cystourethrography
   c. Ultrasonography
   d. Magnetic resonance imaging

3. **Which of the following is not a management strategy for feline struvite stone dissolution in most cats?**
   a. Antibiotics
   b. Increasing water intake
   c. Feeding a diet restricted in magnesium, phosphorus, and protein
   d. Feeding a urine-acidifying diet

4. **Which of the following is part of the medical management to prevent recurrence of feline calcium oxalate uroliths?**
   a. Provide vitamin D supplementation
   b. Increase dietary oxalate
   c. Increase water intake
   d. Acidify the urine

5. **Which of the following is not a treatment option for calcium oxalate cystoliths in a female cat?**
   a. Urohydropropulsion
   b. Cystotomy
   c. Percutaneous cystolithotomy
   d. Dissolution by nutritional management

6. **For a cat presenting with feline lower urinary tract disease, which of the following is not a risk factor for urinary tract infection?**
   a. Feeding a calculolytic diet
   b. Female sex
   c. Urolithiasis
   d. Previous perineal urethrostomy

7. **Which of the following is not a feeding recommendation for cats with feline idiopathic cystitis?**
   a. Transition to a new diet gradually
   b. Feed a canned diet
   c. Add water to dry kibble
   d. Feed in close proximity to litterbox and water bowl

8. **Which of the following is not a component of multimodal environmental modification?**
   a. Obtaining a second cat as a companion to the first
   b. Maintaining excellent litterbox hygiene
   c. Providing multiple comfortable rest areas
   d. Offering food and water away from noisy appliances

9. **Hypercalcemia increases the risk for which cause of feline lower urinary tract disease?**
   a. Struvite urethral plugs
   b. Feline interstitial cystitis
   c. Urothelial cell carcinoma
   d. Calcium oxalate stones

10. **What is the most common age at presentation for feline interstitial cystitis?**
    a. 0–24 months
    b. 2–7 years
    c. 7–12 years
    d. >12 years