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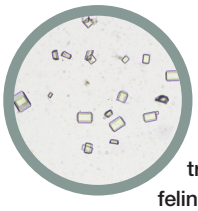
PRACTICE GUIDELINES

2025 iCatCare consensus guidelines on the diagnosis and management of lower urinary tract diseases in cats



Practical relevance: Lower urinary tract signs (LUTS) such as dysuria, haematuria, periuria, pollakiuria and stranguria can occur as the result of a variety of underlying conditions and diagnostic investigation is required to uncover the underlying cause and select appropriate treatment.

Aim: The '2025 iCatCare consensus guidelines on the diagnosis and management of lower urinary tract diseases in cats' provide an overview of the common presenting signs caused by underlying feline lower urinary tract (LUT) diseases in cats, which often are indistinguishable between different underlying causes. The Guidelines set out a diagnostic approach to affected cats before focusing on the most common causes of LUTS: feline idiopathic cystitis (FIC), urolithiasis, urinary tract infection and urethral obstruction. The aim is to provide practitioners with practical information on these problematic conditions.

Clinical challenges: The fact that LUTS are similar despite different underlying causes creates a diagnostic challenge. The most common cause of LUTS, FIC, is challenging to manage due to a complex pathogenesis involving organs outside the LUT. Urethral obstruction is a life-threatening complication of various underlying LUT diseases and recurrent LUTS can lead to relinquishment or euthanasia of affected cats.

Evidence base: These Guidelines have been created by a panel of experts brought together by International Cat Care (iCatCare) Veterinary Society (formerly the International Society of Feline Medicine [ISFM]). Information is based on the available literature, expert opinion and the panel members' experience.

Keywords: Urolithiasis; cystitis; urinary tract infection; stress; urethral obstruction; catheterisation; urine

international cat care VETERINARY SOCIETY

Samantha Taylor BVetMed(Hons), CertSAM, DipECVIM-CA, MANZCVS, FRCVS*
Panel Chair
International Cat Care, Tisbury, Wiltshire, UK

Søren Boysen DVM, DACVECC
Faculty of Veterinary Medicine, University of Calgary, AB, Canada

Tony Buffington DVM, PhD, DACVIM (Nutrition)
Veterinary Medicine and Epidemiology, University of California-Davis, Davis, CA, USA

Serge Chalhoub BSc (Hons), DVM, DipACVIM (SAIM)
Faculty of Veterinary Medicine, University of Calgary, AB, Canada

Pieter Defauw DVM, PhD, DipECVIM-CA
Lumbry Park Veterinary Specialists, Alton, Hampshire, UK

Mikel M Delgado PhD, Certified Applied Animal Behaviorist
Feline Minds, Sacramento, CA, USA

Danièlle Gunn-Moore BSc (Hons), BVM&S, PhD, MANZCVS (Feline), FHEA, FRSB, FRCVS
Royal (Dick) School of Veterinary Studies, and The Roslin Institute, University of Edinburgh, UK

Rachel Korman BVSc, MANZCVS (Int Med), FANZCVS (Fel Med)
Cat Specialist Services, Brisbane, QLD, Australia

*Corresponding author:
sam.taylor@icatcare.org

Introduction

Lower urinary tract signs (LUTS) in pet cats (*Felis catus*) include variable combinations of dysuria, haematuria, periuria, pollakiuria and stranguria (Figure 1), and can result from a range of pathologies. These are common presentations in feline patients, and often chronic and recurrent in nature.[1–3] They are caused by various lower urinary tract (LUT) diseases, most frequently idiopathic cystitis. Urethral obstruction (UO), which occurs almost exclusively in male cats, is a manifestation of LUT disease with life-threatening complications.[4] Diagnosis of the cause of LUTS and management of the LUT disease can be challenging for practitioners and frustrating for caregivers, and conflicting results in published studies add to the complexities.

Also, terminology in this area of medicine has changed over the years, which likely contributes to misunderstanding by caregivers and clinicians. 'Feline urologic syndrome' was a term used initially in the 1970s,[5] while 'feline lower urinary tract disease' (FLUTD), introduced in the 1980s, remains widely used as an umbrella term to describe a multitude of conditions causing LUTS.[4,6] The acronym 'FLUTD' is not a diagnosis and does not describe the cause of the signs; nor does it

RESOURCE FOR CAREGIVERS

iCatCare has produced a resource for caregivers to complement the information and advice offered in these Guidelines.

✣ Understanding urinary tract diseases and how to help cats at home: a guide for caregivers

Available as supplementary material.

Also at:
icatcare.org/cat-advice/cat-carer-guides

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CONTENTS page

Figure 1 **Lower urinary tract signs in cats include dysuria, haematuria, periuria, pollakiuria and stranguria in various combinations, and are caused by a variety of underlying pathologies.** *Image courtesy of Samantha Taylor*

These Guidelines refer to 'lower urinary tract diseases' to encompass the multiple causes of lower urinary tract signs, rather than imply any single diagnosis.

assist with caregiver understanding of the complex pathophysiology of many underlying LUT diseases. Unfortunately, use of the term 'FLUTD' may also encourage a diagnostic endpoint, despite the variety of underlying causes.[7,8] These Guidelines refer to 'LUT diseases' to encompass the multiple causes of LUTS; 'diseases' is intentionally plural so as not to imply any single diagnosis.

A common cause of LUTS, 'feline idiopathic (interstitial) cystitis', is also inappropriately named.[9,10] This condition in cats is generally not associated with a significant inflammatory response, and the term 'interstitial,' which was adopted because of similarity with human interstitial cystitis (bladder pain syndrome), poorly explains the condition and fails to encompass its association with wider pathology of (other) organ, endocrine, and peripheral and central nervous systems (see 'Feline idiopathic cystitis').[11] Use of the term 'cystitis' in discussion with caregivers may imply a bacterial cause (as is common in people), encouraging the overprescription of antibiotics for what is frequently a sterile condition. Nevertheless, the term 'feline idiopathic cystitis' is used widely by veterinary professionals and in publications. Hence 'FIC' remains the term used in these Guidelines to describe the idiopathic condition commonly causing LUTS.

For ease of reference, Box 1 provides a glossary of terms used in these Guidelines.

Is there a better name for feline idiopathic cystitis?

The term 'feline idiopathic cystitis' may not be optimal for promoting caregiver and veterinarian understanding of the disease. Alternative names such as 'bladder pain syndrome', as used in human medicine, may be preferred in the future to avoid associations with infection and emphasise the need for analgesia; moreover, the inclusion of 'syndrome' indicates that this may be part of a group of pathologies, including those outside the bladder.

Box 1

Glossary of terms used in these Guidelines in relation to lower urinary tract diseases

- **Central threat response system** Area of the brain that responds to threat with activation of various nervous and endocrine systems and can become sensitised by epigenetics, genetics and life experiences.
- **Dysuria** Difficulty urinating.
- **Feline idiopathic cystitis, feline interstitial cystitis, idiopathic cystitis** Terms used interchangeably to describe the most common cause of LUTS: the bladder's response to persistent activation of the central threat response system.[12] *In these Guidelines 'FIC' refers to feline idiopathic cystitis.*
- **Feline lower urinary tract disease (FLUTD)** Non-specific (outdated) term encompassing the multiple conditions presenting with clinical signs of dysuria, haematuria, periuria, pollakiuria and stranguria.
- **Haematuria** Blood in the urine.
- **Lower urinary tract (LUT) diseases** Preferred term to encompass the multiple conditions presenting with clinical signs of dysuria, haematuria, periuria, pollakiuria and stranguria.
- **Lower urinary tract signs (LUTS)** Clinical signs (dysuria, haematuria, periuria, pollakiuria and stranguria) resulting from multiple underlying pathologies.
- **Multimodal environmental modification (MEMO)** Institution of changes in the cat's environment to attempt to reduce LUTS by decreasing the likelihood of activation of the central threat response system.[13]
- **Pandora syndrome** Term proposed to describe the presence of clinical signs referable to other organ systems (eg, vomiting, overgrooming), in addition to chronic signs referable to the particular organ(s) for which the patient is being evaluated (in this case bladder and urethra). Pandora syndrome is characterised by waxing and waning of clinical signs associated with events that (presumably) activate the central threat response system, as well as by resolution of all signs with the institution of effective environmental enrichment.[12]
- **Periuria** Urination outside the litter tray/box. Distinct from urine spraying or marking, which is defined as depositing urine, usually on vertical surfaces, for the purpose of communication.
- **Pollakiuria** Increased frequency of urination.
- **Sickness behaviours** Non-specific clinical and behavioural signs that include variable combinations of vomiting, diarrhoea, anorexia (or reduced food and water intake), fever, lethargy, somnolence, enhanced pain-like behaviours, and decreased general activity, body care activities (grooming) and social interactions.[14,15]
- **Stranguria** Straining to urinate (may be misinterpreted by caregivers as straining to defecate).
- **Subclinical bacteriuria** Presence of bacteria in the urinary tract, with or without inflammation but with no clinical signs.[16]
- **Urethral obstruction (UO)** Functional or structural obstruction of the urethra, causing life-threatening clinical consequences.
- **Urethral plug** Proteinaceous matrix of inflammatory debris and crystals causing UO, often in the distal penis.
- **Urinary tract infection (UTI)** Multiplication of an organism in the urinary tract, causing inflammation and clinical signs.[17]
- **Urolithiasis** Organised concretions of crystalloid and organic material, occurring anywhere in the urinary tract.

The aim of the '2025 iCatCare consensus guidelines on the diagnosis and management of lower urinary tract diseases in cats' is to provide primary care practitioners with a review of the literature and easy-to-access practical information to assist in the approach to, and management of, these challenging cases.

Presenting signs of lower urinary tract diseases

As mentioned, despite different underlying causes, the presenting signs of LUT diseases in cats are broadly similar and include dysuria, haematuria, periuria, pollakiuria and stranguria. Periuria (urination outside the litter tray) is a common sign of LUT diseases.[18,19] Distinguishing periuria from urine spraying is essential to differentiate medical and behavioural causes (Box 2). Importantly, LUT diseases should be excluded before a behavioural cause is assigned when a cat presents with urination outside the litter tray.

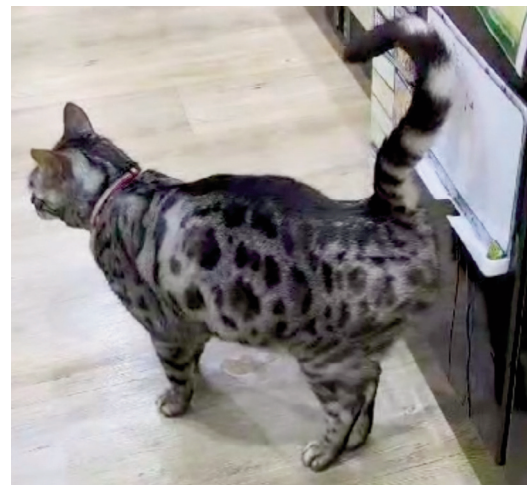


Figure 2 **Young Bengal cat adopting a standing position, with erect quivering tail, typical of urine spraying as a problem behaviour.** *Image courtesy of Linda Ryan*

Box 2

Urine spraying vs urination outside the litter tray

Urine spraying (or marking) is defined as the deposition of urine, usually on vertical surfaces, for the purpose of communication (Figure 2).[20] Cats showing this behaviour require exclusion of LUT diseases as a cause, but in most cases no underlying pathology is found.[21] In other words, spraying may be more indicative of an undesirable problem behaviour in response to stressors in the environment rather than a sign of an LUT disease.[20,22] For further information, readers are referred to 'Common feline problem behaviors: urine spraying' by Horwitz.[20]

Urinary incontinence is an unusual but important presenting sign of LUT diseases (discussed later). Non-urinary signs may include overgrooming of the abdomen (Figure 3), perineum and hindlimbs, indicating underlying pain, and non-specific signs such as lethargy and hyporexia. Weight loss, polydipsia/polyuria and gastrointestinal signs may occur in cats with comorbidities such as chronic kidney disease (CKD). Cats with UO may present with mild to severe systemic illness, as well as unproductive stranguria (which caregivers may mistake for straining to defecate).

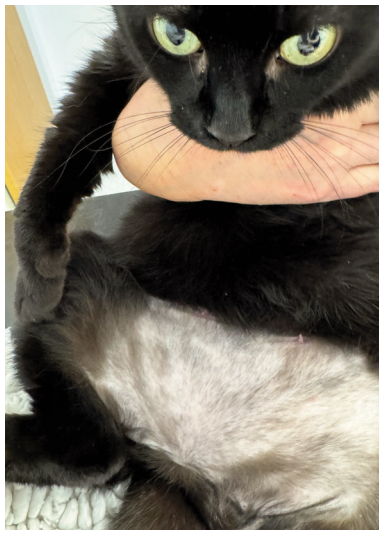


Figure 3 **Overgrooming of the abdomen in a cat with idiopathic cystitis.** *Image courtesy of Samantha Taylor*

Causes of lower urinary tract diseases

In various studies that have examined the prevalence of LUT diseases over the past three decades or so, a cause in around 55–65% of cases could not be established, and cats were classified as having FIC.[8,18,19,23,24] Conditions causing LUTS (Box 3) may present with or without UO and may be multifactorial and involve behavioural factors.

Diagnostic approach to cats with lower urinary tract signs

As presenting LUTS often may not differ between the various underlying causes of LUT diseases, a logical approach to investigation is essential, though may be tailored according to the severity of clinical signs, patient history and number of similar episodes that have occurred previously, as well as caregiver finances. Figure 4 describes a summary of the approach to affected cats. Importantly, aetiologies may vary between episodes of LUT diseases, so it should not be assumed that recurrent LUTS always have the same underlying cause.[24]

It should not be assumed that recurrent lower urinary tract signs always have the same underlying cause.

History-taking

In addition to recording the LUTS and signs referable to other organ systems (inappetence, vomiting, etc) reported by the caregiver, environmental and behavioural aspects may be pertinent, warranting a more thorough history (see 'Environmental and behavioural considerations for management of lower urinary tract diseases', and the questionnaire for caregivers of cats with lower urinary tract signs in the supplementary material). For cats with outdoor access, urination may not be observed, but perineal staining, overgrooming of the abdomen, perineum or hindlimbs, and unusual urination indoors may suggest an LUT disease. The colour and volume of urine passed should be recorded, if known (eg, by assessing the size of the deposit [or 'clump'] where clumping litter is used).

Physical examination

General examination and recording of vital signs should be performed, and body weight and body/muscle condition score assessed. Assessment of hydration is also important, particularly for cats with UO. Physical examination will rarely provide a diagnosis but may guide further investigations. It should include kidney and bladder palpation. The latter may identify a painful, firm, distended bladder, consistent with UO, or a small, thickened bladder with other LUT diseases. Uroliths are rarely palpable.[25] Perineal examination is important and occasionally gritty material can be seen adherent to the prepuce, or there may be evidence of self-trauma.

Laboratory testing

Serum biochemistry and a complete blood count may be indicated. Although rarely providing a diagnosis of LUT disease, comorbidities may be detected as well as abnormalities that may influence further tests and treatment choices. Triage of cats with suspected UO is discussed later.

Urinalysis

Urinalysis is a vital part of the investigation of all LUT diseases. Results should be assessed in the light of the cat's diet (wet or dry), urine collection method, and sample storage and handling, to avoid any misinterpretation (Box 4). USG (prior to fluid therapy) should be measured with a refractometer. A dipstick assessment and timely (within 1 h) sediment examination should also be performed.[29,30] Artefactual crystalluria (struvite or calcium oxalate) can occur if samples are analysed over an hour after collection, or are refrigerated.[27,31]

Box 3

Causes of lower urinary tract signs in cats

- FIC (most common)
- Urolithiasis
- Infectious diseases (bacterial, fungal)
- Urethral trauma (catheterisation, external trauma, previous urolithiasis)
- Neurogenic conditions (urethral spasm, reflex dyssynergia, detrusor atony)
- Neoplastic disease (urothelial carcinoma [UC; transitional cell carcinoma], squamous cell carcinoma, lymphoma)
- Anatomical abnormalities (congenital, acquired [strictures])

Note that UO (and urethral plugs) are not included in this list because they are a consequence/manifestation of underlying causes, rather than a standalone diagnosis. FIC = feline idiopathic cystitis

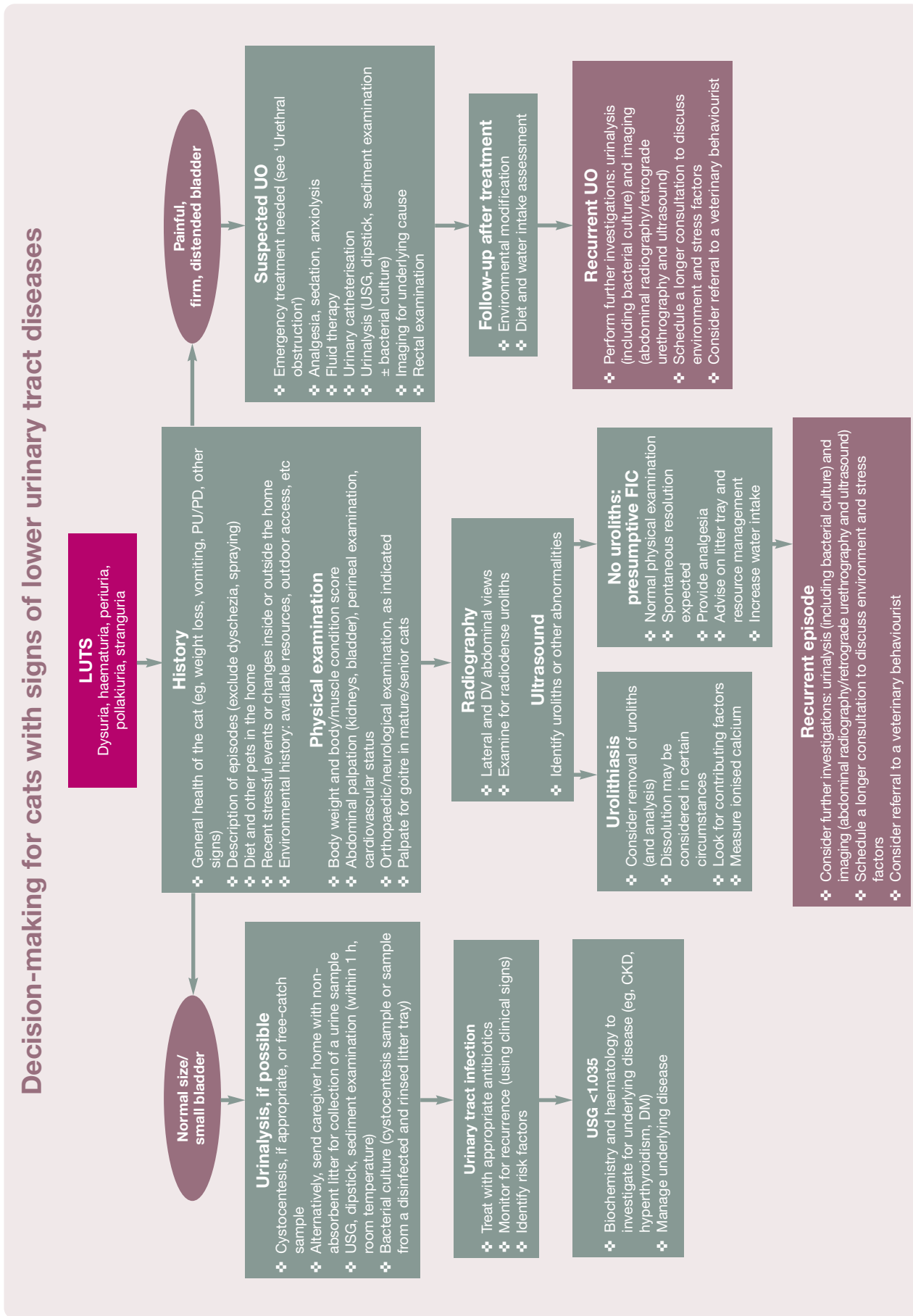


Figure 4 Algorithm for the approach to cats with signs of lower urinary tract (LUT) diseases. CKD = chronic kidney disease; DM = diabetes mellitus; DV = dorsoventral; FIC = feline idiopathic cystitis; LUTS = lower urinary tract signs; PU/PD = polyuria/polydipsia; UO = urethral obstruction; USG = urine specific gravity. See relevant sections of the Guidelines for further information on many aspects listed in the algorithm, including emergency treatment of UO

Box 4

Practical urinalysis tips

- Always measure urine specific gravity (USG) with a refractometer. A result <1.035 suggests suboptimal concentrating ability in a patient not receiving fluid therapy.
- USG, leukocyte and nitrate indicators on dipsticks are not reliable in cats.[26]
- Cystocentesis can lead to iatrogenic haematuria, which needs to be distinguished from a pathological cause by checking a free-catch sample collected at home 24–48 h later.
- If cystocentesis is not possible, a urine sample can be collected from a clean (disinfected and rinsed) litter tray using fresh non-absorbent litter.
- Urine sediment examination should be performed on recently (<1 h) voided urine to avoid artefactual changes such as crystal formation or disappearance of casts (or findings interpreted accordingly if the sample is older).[27]
- Urine pH can be affected by stress, diet and timing of feeding; hence, repeated measurements are needed to identify a trend and/or to monitor results of interventions.
- Urine protein should be quantified by measuring the urine protein:creatinine ratio (taking into account the effect of inflammation/haematuria).
- Crystalluria can be a normal finding in healthy cats and also artefactual due to delayed examination (eg, transit to the laboratory); hence, it should not be overinterpreted.
- Lipiduria is a normal finding in cats and can be seen on ultrasound as hyperechoic, non-shadowing debris.
- Alpha-2 agonists used for sedation can result in diuresis and falsely low USG readings.[28]

Figure 5 shows the microscopic appearance of haematuria and common urine crystals.

For bacterial culture, urine should preferably be obtained via cystocentesis before any antimicrobial therapy is given, and submitted for quantitative culture and antibiotic sensitivity testing.[17] Manual expression is not recommended as it will cause pain and stress, and potentially damage to the bladder wall. A cat friendly approach to patient interactions – centred on understanding and responding to the current emotional state of the cat – may facilitate conscious cystocentesis (Figure 6). Practical guidance is available in the '2022 AAFP/ISFM cat friendly veterinary interaction guidelines: approach and handing techniques'.[32] Catheterisation for urine sampling is not generally recommended as it may cause trauma and samples may be contaminated; nor should urine be cultured from urine collection bags.[16]

Figure 5 Microscopic appearance of (a) haematuria, (b) struvite crystalluria, (c) calcium oxalate dihydrate crystalluria and (d) a bilirubin crystal. *Images courtesy of (a–c) Francesco Cian and (d) Iona Mayer (d)*

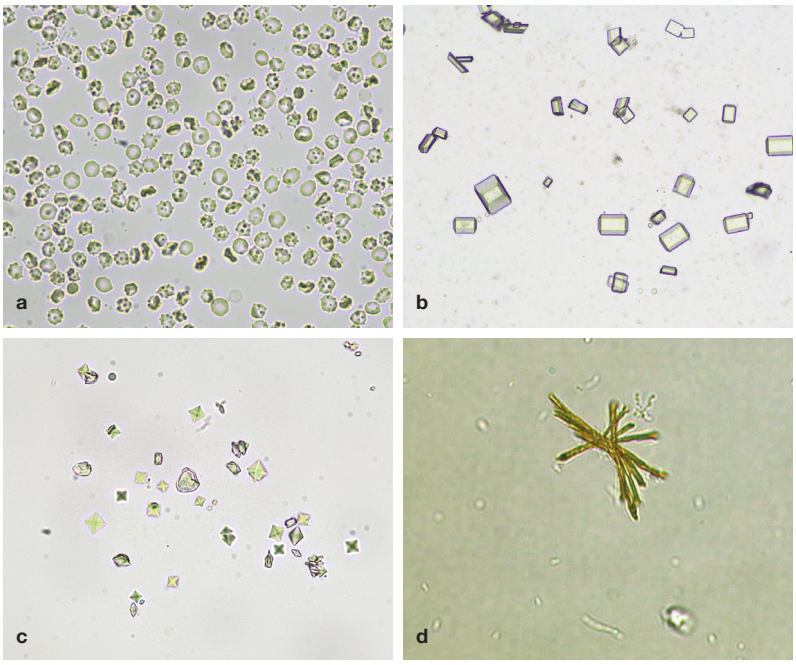


Figure 6 Gentle, cat friendly interactions can facilitate conscious cystocentesis. *Image courtesy of Richard Murgatroyd*

Imaging

Imaging can be very valuable for the assessment of cats with recurrent or severe LUTS. It is also indicated for diagnosing or excluding urolithiasis and is recommended for cats with signalment, clinical signs or physical examination findings that are atypical for FIC (eg, older cats, or cats with palpable bladder abnormalities or incontinence).

Radiography

Survey abdominal radiographs may be useful for detection of radiodense uroliths (Figure 7)

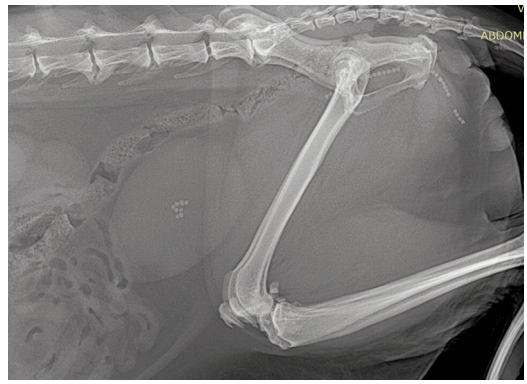


Figure 7 Lateral abdominal radiograph showing radiopaque uroliths in the bladder and urethra of a cat. *Image courtesy of Rachel Korman*

Box 5

Retrograde urethrography

Retrograde urethrography is a useful technique to assess the patency of the intrapelvic and distal urethra and to identify strictures, ruptures and filling defects, for example. It is performed under sedation or general anaesthesia.

- Perform plain radiography to assess for radiopaque uroliths or other abnormalities; the urinary bladder should be moderately distended.
- Obtain a urine sample prior to instillation of contrast media, if required for urinalysis.
- An enema or manual evacuation of faeces may aid visualisation of the urethra.
- Fill the urinary catheter with sterile saline or contrast prior to placement, to avoid gas bubbles within the urethra causing iatrogenic artefactual filling defects.
- Using a sterile technique (sterile gloves, clipping of long hair and gentle cleaning of the area with appropriate products), place the catheter into the urethra as distally as possible; choose an open-ended catheter (an IV catheter without stylet may also be used). Only the tip of the catheter should be introduced (to avoid missing distal urethral pathology) and placement can be checked with a radiograph. If the prepuce needs to be clamped gently around the catheter to keep it in place, a swab must be placed between the prepuce and clamp (bowel/tongue forceps), and tissue trauma and pressure on the penis avoided (Figure 9).
- For female cats, vaginourethrography can be performed using a Foley catheter placed just inside the vagina, with the bulb gently inflated and the lips of the vulva clamped around it, similar to the above description for male cats.
- Iodinated, water-soluble contrast medium (150–200 mg iodine/ml) should be injected slowly, without excessive pressure (1 ml/kg).
- Lateral radiographs should be taken during the last stage of injection/immediately after injection (Figure 10). To assess for potential urethral ruptures, an additional lateral radiograph can be taken 3–5 mins post-contrast injection. Additional ventrodorsal oblique views may help to avoid superimposition of structures.

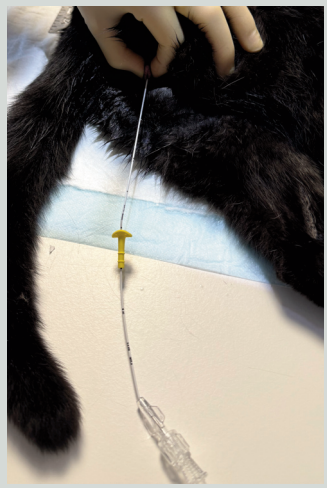


Figure 9 **A urinary catheter with attached syringe filled with contrast material placed in the distal penis. The catheter can be held in place with forceps; a swab placed between the forceps and prepuce can limit trauma.** *Image courtesy of Samantha Taylor*

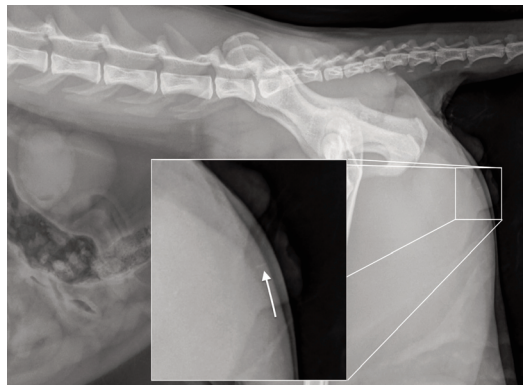


Figure 8 **Lateral radiograph of the caudal abdomen of a cat, with a region of the penis magnified. The faint long tubular thin mineral opacity (arrow) at the level of the penis is consistent with the os penis.** *Image courtesy of Lumbry Park Veterinary Specialists*

and should include lateral and dorsoventral views that span the abdomen and incorporate the pelvic and penile urethra. An enema may facilitate visualisation.[33] In males, the os penis can be present and should not be mistaken for distal urethral urolithiasis (Figure 8).[34] Contrast radiography (retrograde urethrography [Box 5] or urethrocystography) is relatively easy to perform, cost-effective and can provide valuable information in cats with LUT disease, particularly those with UO. However, ultrasound examination has generally replaced contrast radiography, when available.

Ultrasound

Ultrasound examination of the bladder allows identification of calculi (Figure 11), masses, blood clots, echogenic debris and congenital abnormalities.[35] Examination of the kidneys, ureters and other abdominal organs may additionally be indicated and peritoneal/retroperitoneal fluid may be identified. Importantly, ultrasound does not allow examination of the intrapelvic or penile urethra,

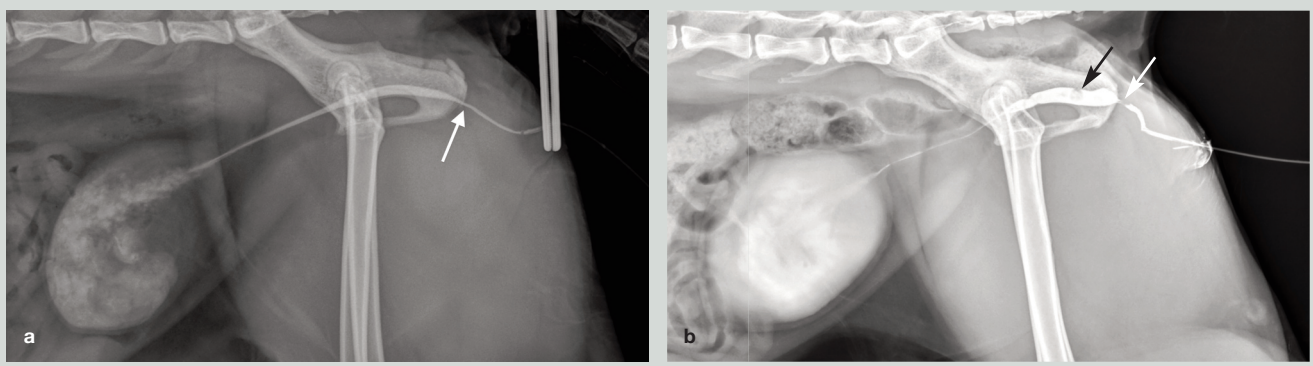


Figure 10 **(a) A normal retrograde study and (b) a retrograde urethrogram revealing a stricture and urolith, in two male cats. Narrowing of the urethra, as indicated by the arrow in image (a), is a normal finding and should not be mistaken for a focal stenosis. In image (b), there is a stricture (white arrow) and a filling defect in a dilated section of the intrapelvic urethra (black arrow), consistent with a urolith. This cat later underwent a perineal urethrostomy and several calcium oxalate uroliths were removed.** *Images courtesy of (a) Lumbry Park Veterinary Specialists and (b) London Vet Specialists*

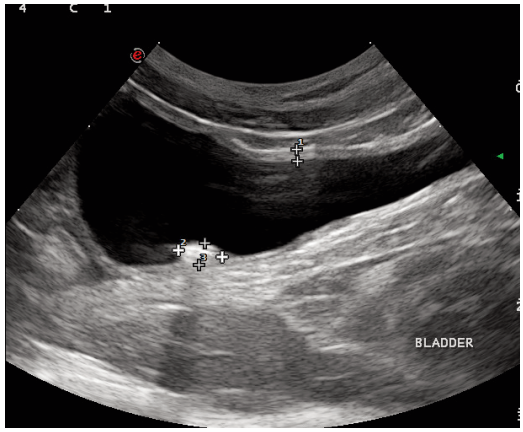


Figure 11 **Ultrasound image showing a cystolith with acoustic shadowing, along with a thickened bladder wall.** *Image courtesy of Samantha Taylor*

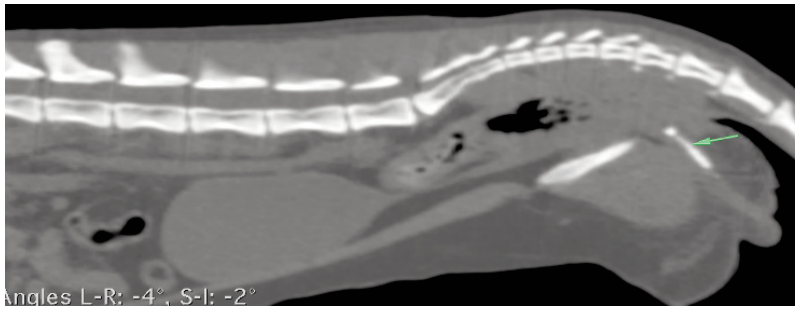


Figure 12 **Sagittal CT image from a 4-year-old cat presenting with incontinence. The green arrow shows a mineral material plug in the penile urethra that was causing a partial obstruction.** *Image courtesy of Samantha Taylor*

locations where pathology is commonly found in cats both with and without UO. Therefore, abdominal radiography (including the caudal abdomen), plus ideally retrograde urethrography and/or rectal examination, is needed to exclude small stones, for example, in this region. Ideally, both imaging modalities are recommended to fully assess the urinary system.

For a clinical review on urinary tract ultrasonography, readers are referred to 'Feline abdominal ultrasonography: what's normal? What's abnormal? Renal pelvis, ureters and urinary bladder' by Griffin.[35]

Feline idiopathic cystitis should be considered a systemic disorder.

Advanced imaging

CT scans are rarely indicated in cases of LUT disease (Figure 12) but do allow identification of anatomical abnormalities (congenital or acquired). MRI scanning may be required to investigate uncommon neurological causes of LUTS (eg, incontinence or urinary retention).

Cystourethroscopy

Cystourethroscopy can be performed in female cats to visualise masses, uroliths or glomerulations, and to facilitate their biopsy or removal via minimally invasive techniques.[36] However, the small size of feline patients limits availability of this technique.

Feline idiopathic cystitis

FIC is the most common cause of LUTS in cats,[4,37] and the condition has similarities to interstitial cystitis in humans (also called

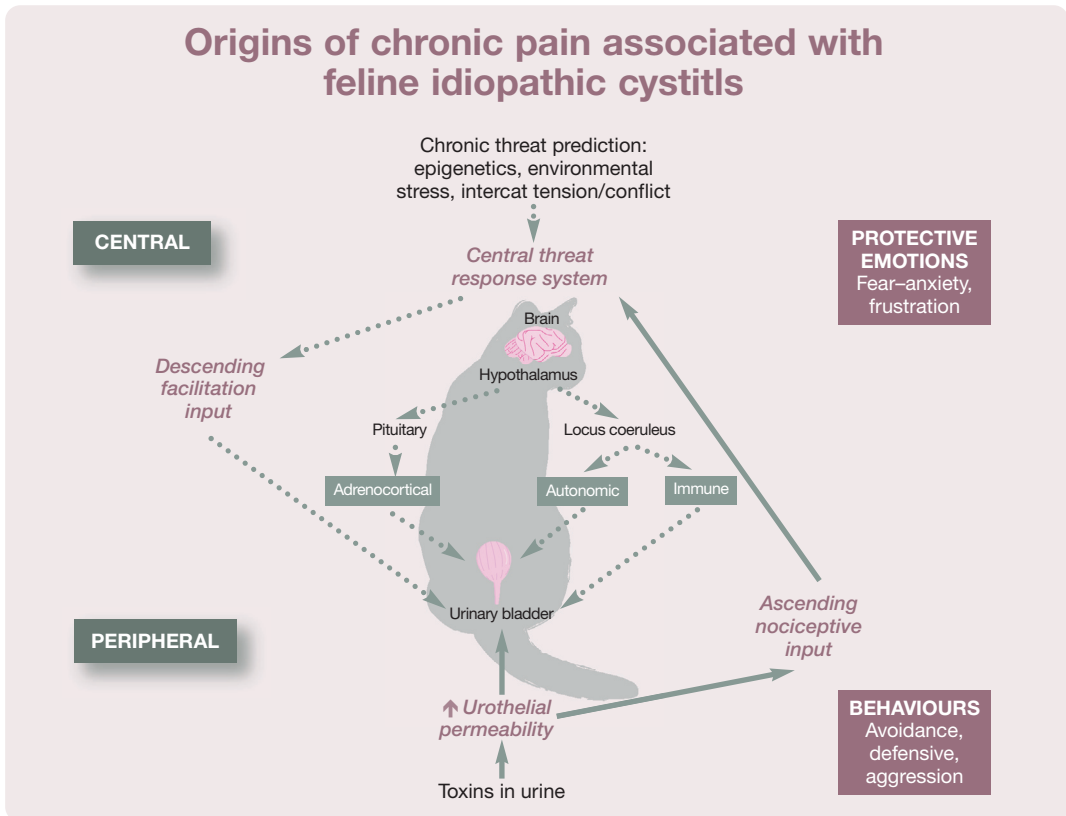


Figure 13 **Schematic diagram of chronic pain associated with feline idiopathic cystitis (FIC). FIC has long been thought to result from some toxins in the urine and/or a urothelial permeability defect, which leads to 'bottom-up' nociceptive input to the brain (solid arrows). 'Top-down' (dotted) arrows show how this activation of the central threat response system affects the bladder, causing signs of FIC. More recent studies have found that environmental threats can also result in signs of FIC via top-down input to the central threat response system.** *Adapted from Koban et al,[39] courtesy of Tony Buffington*

bladder pain syndrome, among other terms)[10] with respect to abnormalities seen in the bladder, the presence of comorbid conditions, and the relationship with stress.[10,38] FIC should be considered a systemic disorder also involving organs other than the bladder,[12] and affected cats may have overlapping health problems (sickness behaviours, 'Pandora' syndrome).[9] In cats with FIC, the presenting signs can be considered the bladder's response to persistent activation of the central threat response system, which is influenced by genetic, epigenetic and environmental factors.[37] Therefore, investigation and management of cats with FIC should look 'beyond the bladder'.[12]

Pathogenesis

FIC results from multiple complex and variable nervous, endocrine and immune abnormalities (Figure 13) that not only affect the cat's bladder but also their behaviour, and other organ (including skin and gastrointestinal tract) function.[4]

Risk factors

Studies examining potential risk factors for FIC have generally reported consistent findings, with identified risk factors including genetics, early adverse experiences, nervous disposition, indoor environment, increased threat responsiveness, frequent diet change, inactive lifestyle, obesity, use of non-clumping litter, multi-cat home, household instability, and lack of elevated vantage points.[40–42] These risk factors suggest that FIC is a condition primarily affecting susceptible cats living in provocative environments, and that effective management must address the cat's environment and lifestyle, as well as their bladder pathology.[4]

Diagnosis

Diagnosis of FIC is one of exclusion, taking into consideration the number and type of episodes, severity of clinical signs (including comorbidities) and financial resources of the caregiver. No sensitive, specific and clinically available diagnostic test currently exists to confirm FIC; hence, diagnosis is based on signalment, history, risk factors, exclusion of other causes of LUTS (ideally involving imaging) and response to treatment.[37]

Management

In most cases, LUTS will resolve in 2–7 days (with or without treatment), but recurrence is common. Given the multifactorial nature of FIC, individual interventions (nutritional modifications or medications) are unlikely to be effective as sole therapy, but may be helpful as part of a multimodal approach. Appropriate multimodal environmental modification (MEMO) has been shown to be effective in reducing the recurrence of all disease signs in cats with FIC and is now the standard of practice in veterinary medicine for management of this condition.[13,37] MEMO is the institution of changes to the cat's environment to attempt to reduce LUTS by decreasing the likelihood of activation of the central threat response system. This approach incorporates caregiver education, and variable combinations of changes to the cat's inanimate physical environment, as well as their diet and their interactions with other cats, other animals and humans in their environment. Clinicians should remember that FIC is a painful condition and analgesia should be prioritised.

Diagnosis of feline idiopathic cystitis is one of exclusion, taking into consideration the number and type of episodes, severity of clinical signs (including comorbidities) and financial resources of the caregiver.

Pharmacological interventions

Various medications have been used to manage FIC but few have been robustly studied or compared with MEMO in terms of efficacy. The stress of orally medicating cats should be considered when prescribing and may also complicate assessment of the response.

Prednisolone,[43] pentosan polysulfate sodium[44,45] and glycosaminoglycans[46,47] have no significant benefit in cats with FIC, although improvements have been seen in both placebo and treatment groups, possibly related to giving medication in treats (hence reducing the perception of threat and encouraging engaging emotions).[48,49] Analgesics such as non-steroidal anti-inflammatory drugs (NSAIDs; meloxicam, robenacoxib), opioids (transmucosal buprenorphine), gabapentin, pregabalin or novel anti-nerve growth factor monoclonal antibodies such as frunevetmab have to date not been studied in non-obstructive FIC. Analgesia is strongly recommended as this is a painful condition. Amitriptyline may be considered in refractory cases,[50] and fluoxetine has been shown to decrease urine spraying.[51] Urinary retention has been reported with fluoxetine.[52]

Although FIC is not a urine-marking condition, behaviour medications may be beneficial in other ways (eg, helping a cat cope with environmental stressors or frustration). Furthermore, a cat who is at risk of losing their home or life due to LUTS and litter tray avoidance should be considered a candidate for behavioural medication when there are indications of anxiety and environmental stressors. Importantly, any use of medications for behavioural modification should ideally be discussed with a board-certified or equivalent veterinary behaviourist and used in parallel with environmental modifications.[53] See 'Scent and pheromones' for a discussion of the potential utility of pheromone therapy for FIC.

Nutritional modifications

Nutritional inventions are unlikely to be effective alone, but may be beneficial as part of the multimodal approach. Studies on nutritional interventions have generally included only small numbers of cats; moreover, dietary changes may in themselves be associated with stress because of the particularly sensitive nature of affected cats. Despite this, a survey of veterinarians in the USA showed that urinary prescription diets were the top choice of treatment for non-obstructive FIC.[54]

Acidification of the urine or feeding diets to reduce struvite crystals is generally not indicated for non-obstructive FIC,[55] although feeding a wet diet and increasing water intake may help to prevent recurrence,[4,13,46] albeit studies are not conclusive. The benefit of adding ingredients to urinary diets to reduce stress (eg, alpha-casozepine, L-tryptophan) has been studied in small numbers of cats with FIC, with significantly fewer cats suffering a recurrent episode in one non-randomised short-term study.[56] In another study, the feeding of a urinary prescription diet reduced the recurrence of some LUTS.[57] However, evidence about the effects of supplementation of these nutrients on long-term FIC management and recurrence is not available.[58] As obesity is a risk factor for FIC, therapy for weight control may be indicated as a long-term goal.

Given the susceptibility of cats with FIC to stress, asking the caregiver what (regulatory-approved) diet their cat prefers, and then suggesting they buy a few different brands to offer the cat to assess their preferences and give choice, may help to reduce activation of the central threat response system.

Radiotherapy

Low-dose radiotherapy is under trial for the management of refractory FIC (go.jfms.com/NCSU_FIC), with publications awaited.[59]

Urolithiasis

Urolithiasis is an important cause of LUTS in cats, accounting for 10–23% of cases.[8,60] It is also an important cause of UO.[18,61] Clinical signs of urolithiasis will vary according to the location and nature of the stone(s), with cystoliths sometimes presenting as an incidental finding and in other cases resulting in haematuria and dysuria. The most common types of urolith are calcium oxalate and struvite (magnesium ammonium phosphate) and these are typically sterile. Together, calcium oxalate and struvite make up around 90% of feline uroliths.[62] Their relative proportions have changed over time, likely driven by dietary trends, with recent studies suggesting that struvite is now more common than calcium oxalate.[60]

Other, less common urolith types include urate, cystine, calcium phosphate (apatite), compound and mixed.[60,63] Solidified blood uroliths have been occasionally reported, usually found in the bladder and urethra.[64,65] In a recent case report, uroliths composed of the antiviral nucleoside analogue GS-441524, used to treat feline infectious peritonitis, were documented in two cats.[66]

Risk factors, laboratory and imaging findings, and management approaches for the most common uroliths are summarised in Table 1. Further information on the management of uroliths is available on the Minnesota Urolith Center website (go.jfms.com/UMN_uroliths) and in the 'ACVIM small animal consensus recommendations on the treatment and prevention of uroliths in dogs and cats'.[73]

Recent studies suggest that struvite uroliths are now more common than calcium oxalate uroliths, likely driven by dietary trends.

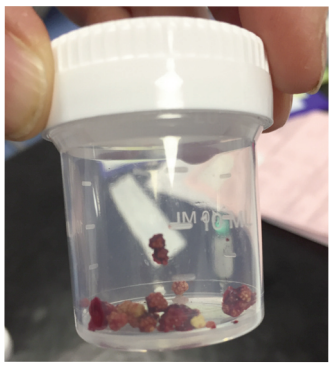


Figure 14 Calcium oxalate cystoliths removed from a Ragdoll via cystotomy. *Image courtesy of Samantha Taylor*

Investigation

Clinical signs of urolithiasis may be indistinguishable from other causes of LUT diseases and, therefore, the investigations described above (see 'Diagnostic approach to cats with lower urinary tract signs') are warranted.

If uroliths are identified, it is appropriate to consider a complete blood count and biochemistry to look for factors contributing to their formation, such as hypercalcaemia (diagnosed in around 35% of cats with calcium oxalate uroliths),[74,75] liver disease such as a portosystemic shunt (urate) or conditions associated with urinary tract infection (UTI) including CKD, hyperthyroidism or diabetes mellitus (struvite). Urinalysis is also indicated in the investigation of urolithiasis, with measurement of USG and pH as well as sediment examination. There are pitfalls to be avoided in the interpretation of results; for example, urolith type does not consistently match crystal type and uroliths can occur without crystalluria. Urine pH can be altered by the stress of coming to the clinic, delays in analysis, diet and timing of feeding.[29] Radiographic imaging should be considered and all uroliths analysed if removed (Figure 14).

Management

Management will depend on the location, suspected composition, size and number of uroliths (Table 1), as well as caregiver and cat factors. Options include medical dissolution, surgical removal via cystotomy, voiding urohydropropulsion or advanced techniques such as cystolithotomy, lithotripsy, cystoscopy or basket removal.

Table 1 Characteristics and management of common feline uroliths

Type of urolith	Risk factors	Clinical pathology	Radiographic appearance	Management
Struvite (magnesium ammonium phosphate)	❖ Sex: female >male ❖ Indoor lifestyle ❖ Can be associated with infection with urease-producing bacteria (uncommon in cats) ❖ Breed: Himalayan, Ragdoll, Chartreux, Oriental Shorthair, Siamese[67,68]	❖ Alkaline urine ❖ Struvite crystalluria is not a consistent finding[25] ❖ Positive bacterial culture uncommon	❖ Mildly to moderately radiopaque if >3 mm diameter ❖ Smooth to moderately irregular	❖ Medical management: low phosphorus/magnesium diet to promote acidic urine (pH <6.4) ❖ Dissolution may take 2–3 weeks and can be monitored with imaging every 2–3 weeks[69] ❖ Antibiotics only needed for infection-induced uroliths (uncommon) ❖ Surgical removal (or non-invasive techniques)[70] should be followed by preventive measures (diet, increasing water intake, urinary acidification) ❖ Monitor USG and pH
Calcium oxalate	❖ Age: mean 7 years ❖ Breed: Persian, Himalayan, British Shorthair, Ragdoll[63,65] ❖ Diets low in sodium or potassium[67,71] ❖ Dietary acidification	❖ Acidic urine ❖ Hypercalcaemia (total and ionised calcium should be measured)	❖ Radiodense ❖ Usually 1–4 mm ❖ Smooth, irregular or spiky	❖ Cannot be medically dissolved; should be removed surgically or using non-invasive techniques[70] ❖ Preventive measures include management of hypercalcaemia, feeding a high-moisture, alkalinising diet and increasing water intake; consider potassium citrate if urine pH remains <6.5 ❖ Supplements of vitamin B6 and administration of hydrochlorothiazide (to normocalcaemic cats) can be considered in recurrent cases ❖ Monitor USG and pH
Urate	❖ Associated with portosystemic vascular anomalies	❖ Hyperammonaemia ❖ Elevated bile acids in cats with portosystemic shunts	❖ Radiolucent ❖ Rounded	❖ Surgical or non-invasive removal; medical dissolution is reported with allopurinol and diet[72] ❖ Preventive measures include management of underlying disease, dietary modification (lower purine/protein), avoidance of acidification (may require potassium citrate) and increasing water intake

USG = urine specific gravity

Urinary tract infections and subclinical bacteriuria

UTI is uncommon as a cause of LUTS in otherwise healthy adult cats (<3%),[18] but the prevalence is higher in certain groups, such as cats with CKD[76] and those over 10 years of age,[17,19] where infection should be considered a potential underlying cause. The finding of bacteria in the urine of cats may or may not be associated with clinical signs (Figure 15). 'Subclinical bacteriuria' (see 'Definitions') increases in prevalence with age and the existence of comorbidities, with one study documenting a prevalence of 6.1% in cats over 6 years old.[77]

Distinguishing subclinical bacteriuria from UTI can be challenging in a species with private elimination habits and often unsupervised outdoor access, and caregivers may underestimate the frequency of urination.[78] This underlines the importance both of caregiver education (see 'Caregiver role and communication') and further diagnostic testing when urine culture is positive. Overprescription of antimicrobials for cats with LUTS remains a concern in the context of antibiotic stewardship.[79–81]

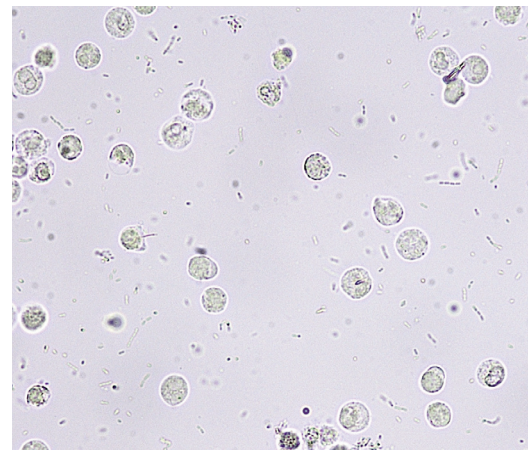


Figure 15 **Bacteriuria can be identified on sediment examination but treatment should take into account the presence or absence of clinical signs.** *Image courtesy of Francesco Cian*

Definitions

❖ **Urinary tract infection (UTI)** – the presence of bacteria (or other infectious agents) in the urinary tract, with an associated local inflammatory response and clinical signs.

❖ **Subclinical bacteriuria** – the presence of bacteria in the urine as demonstrated by a positive urine bacterial culture, without LUTS and with or without signs of inflammation on urine sediment cytology.[16,17]

Box 6

Risk factors for urinary tract infection and subclinical bacteriuria

Signalment/systemic factors
- Increasing age
- Female sex
- Persian and Abyssinian breeds
- CKD
- Diabetes mellitus
- Hyperthyroidism
- Gastrointestinal disease

Urinary tract factors
- Urological surgery (perineal urethrostomy, subcutaneous ureteral bypass)
- Urethral catheterisation
- Incontinence
- Urolithiasis
- Neoplasia
- Congenital abnormalities

The vast majority of UTIs in cats involve a single bacterial species, most frequently a member of the host's own urogenital or faecal microflora (*Escherichia coli*, *Streptococcus* species, *Enterococcus faecalis*, *Staphylococcus felis*).[82] Polymicrobial infections tend to be diagnosed more frequently in cats with indwelling urinary catheters or other comorbidities.[17] *E faecalis* is more likely to be present in cats with subclinical bacteriuria or as part of a polymicrobial infection.[83] *Corynebacterium urealyticum* is a rare cause of UTI but more common in cats undergoing urethral catheterisation or urological surgery.[84]

Fungal UTIs (eg, *Candida* species, *Cryptococcus* species) are documented; comorbidities (eg, diabetes mellitus or CKD), therapies causing immunosuppression (eg, corticosteroids) or a history of recent antibacterial drug therapy are common factors in affected cats.[85,86] Viral infections such as calicivirus,[87] herpesvirus[88] and coronavirus[89] have been suggested as a cause of LUTS,[90,91] but associations have not been consistently demonstrated.[89]

Risk factors

Signalment and both local and systemic factors can predispose cats to the development of UTI and subclinical bacteriuria, with female sex and increasing age being consistently reported (Box 6).[92–96] CKD, diabetes mellitus and hyperthyroidism are the most frequently documented systemic comorbidities.[95] Despite an increased prevalence in cats with CKD, bacteriuria (subclinical or UTI) does not seem to affect disease progression or survival.[97] UTI may, however, contribute to decreased insulin sensitivity in cats with diabetes.[98] Urethral catheterisation and perineal urethrostomy increase the risk of UTI (see 'Urethral obstruction' for a discussion of antibiotic use in UO), but prophylactic antibiosis is not recommended.[16]

Critically important human antibiotics (eg, carbapenems) should not be used to treat feline patients.

Management

Antimicrobial treatment of subclinical bacteriuria is generally not recommended,[16] nor is culture of a multidrug-resistant bacterial species, in itself, an indication to treat (or suggestive of enhanced pathogenicity). Treatment of subclinical bacteriuria may be considered in cats with diabetes mellitus (if bacteriuria is thought to contribute to poor diabetic control) or suspected pyelonephritis, or who are undergoing urinary tract surgery or endoscopy.[16,17]

For cats with clinical signs of UTI, treatment should be based on bacterial culture and sensitivity testing, and analgesics should also be provided (eg, an NSAID, if there are no contraindications, or an opioid). *Enterococcus* species are intrinsically resistant to beta-lactams, cephalosporins, trimethoprim sulfonamide and fluoroquinolones.[99] If treatment is needed while results are pending, a first-line antimicrobial such as amoxicillin or trimethoprim sulfonamide (although the latter can be be difficult to administer to cats) should be selected.[16] A treatment duration of 3–5 days may be adequate for 'simple' UTIs (ie, an otherwise healthy individual), but these are uncommon in cats. Lack of response should prompt further investigation and empirical changes of antibiotic should be avoided. Cats will more commonly have 'complicated' UTIs (ie, comorbidities present), and treatment should be based on culture and sensitivity results, with a recommended duration of treatment of 3–5 days for a first infection or reinfection, and 7–14 days for persistent or relapsing infection.[16] Longer courses may be needed for pyelonephritis.[16]

Third- and fourth-generation cephalosporins (eg, cefovecin) are prescribed for cats with LUTS;[80,81] however, along with fluoroquinolones, these antibiotics should be reserved for cases with clinical signs of UTI, pyelonephritis or bacterial isolates resistant to lower-tier antibiotics. Long-acting cefovecin injections should not be used empirically without urine culture,[16,17] and critically important

human antibiotics (eg, carbapenems) should not be used to treat feline patients.

Alternative approaches to the management of recurrent UTIs are poorly studied in cats. In humans, and anecdotally in animals, probiotics, cranberry extract, D-mannose, bacteriophage (phage) therapy[100] and inoculation with less pathogenic bacteria have been investigated.[101] Frequent voiding (supported by analgesia for degenerative joint disease in older cats), stress reduction and increased water intake will benefit cats with UTIs, and can be encouraged by appropriate environmental modifications/enrichment (see 'Environmental and behavioural considerations for management of lower urinary tract diseases').

Urethral obstruction

UO is a potentially life-threatening consequence of any type of LUT disease. FIC is the most commonly reported cause of obstruction,[4,102] but urolithiasis should be considered and excluded. Urethral plugs (comprising combinations of proteinaceous material, inflammatory cells and crystals) can occur as sequelae of underlying LUT diseases such as FIC and less commonly UTI or urolithiasis (or a combination). Other causes of UO include anatomical abnormalities (strictures, spasm, congenital defects) and occasionally neoplasia.[103,104]

Pathophysiology

Complete UO results in increased intravesicular pressure, leading to bladder wall pressure necrosis and mucosal injury. The increased hydrostatic pressure from obstruction downstream may be transmitted to the ureters and kidneys; and, when renal pressure exceeds glomerular filtration pressure, renal blood flow and glomerular filtration rate decrease. Tubular concentrating ability is subsequently affected, leading to impaired sodium and water reabsorption, with impaired excretion of phosphorus, potassium, blood urea nitrogen, creatinine and hydrogen ions.[104–106]

Severe metabolic derangements, such as hyperkalaemia, metabolic acidosis and hypocalcaemia, can develop. Hyperkalaemia is the most common life-threatening complication and can lead to bradycardia and cardiac arrhythmias (exacerbated by hypocalcaemia). Uraemia is seen within 24–48 h when UO is complete and acute. Ongoing gastrointestinal losses and decreased fluid intake (vomiting, anorexia) can lead to marked dehydration, azotaemia and hypovolaemia.

If left untreated, complete UO can result in severe bradycardia, bladder rupture, uroabdomen, concurrent shock and death.[106,107]

Box 7

Triage of cats with suspected urethral obstruction

When a cat (particularly a male) arrives with a history of straining to urinate (or defecate, as this can be misinterpreted by caregivers), triage should be performed to identify whether immediate treatment is required. Assessment includes:

- Mentation
- Mucous membrane colour
- Capillary refill time
- Heart rate and rhythm
- Pulse quality
- Systolic blood pressure
- Respiratory rate and lung sounds
- Bladder size and tension (via gentle abdominal palpation)
- Examination of the perineum/prepuce (if this does not cause stress)
- Body weight (taking into account bladder volume)
- Rectal temperature (note can cause stress/pain; hence measure after analgesia/sedation or consider axillary)[108]

The findings will direct further investigation and treatment.

Cats presenting with lower urinary tract signs should be triaged rapidly.

Triage

Cats presenting with LUTS should be triaged rapidly (Box 7) to determine if they have UO and life-threatening consequences such as shock (bradycardia, hypothermia, hypotension) and hyperkalaemia. Figure 16 presents an algorithm to assist decision-making and initial management for feline UO.

Diagnosis

- **History and presenting signs** The importance of collecting a complete (including behavioural) history was touched on in the section 'Diagnostic approach to cats with lower urinary tract signs' and is discussed later (see 'Environmental and behavioural considerations for management of lower urinary tract diseases'). The most frequent presenting signs include straining unproductively (and sometimes also vocalising) in the litter tray. Caregivers may mistake dysuria for constipation. Pollakiuria, periuria and haematuria may be seen before complete UO and failure to pass any urine. When UO has been present for more than 24 h, signs of systemic illness develop, including vomiting, anorexia, lethargy, altered mentation, weakness and stupor. Cats with severe prolonged obstruction may present collapsed in lateral recumbency.
- **Physical examination** Findings may include dehydration, tachypnoea, bradycardia, hypothermia, a painful, firm, distended urinary bladder and signs of shock (poor pulses, cool extremities). Rectal examination to detect urethral stones can be performed in collapsed or sedated cats.

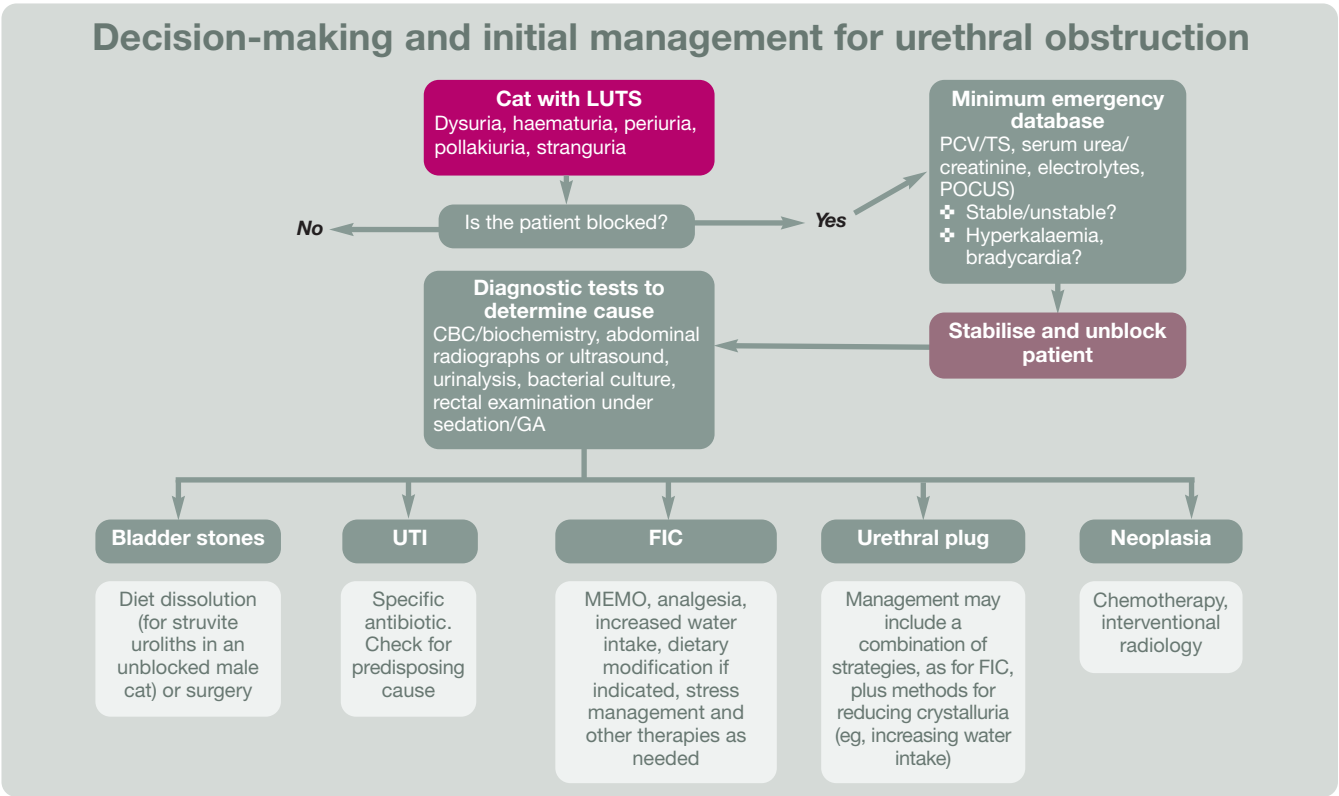


Figure 16 Algorithm for the approach to cats with suspected urethral obstruction. CBC = complete blood count; FIC = feline idiopathic cystitis; GA = general anaesthesia; LUTS = lower urinary tract signs; MEMO = multimodal environmental modification; PCV = packed cell volume; POCUS = point-of-care ultrasound; TS = total solids; UTI = urinary tract infection

❖ **Serum biochemistry** Azotaemia, hyperkalaemia, hypocalcaemia, hypoalbuminaemia, and varying degrees of hyponatraemia, hyperphosphataemia and hyperglycaemia are frequent findings.[106,109] Serum symmetric dimethylarginine levels may be increased (≥20 µg/dl).[110] The combination of bradycardia (heart rate <140 beats per minute [bpm]) and hypothermia (<35.5°C) is strongly correlated (>98% predictive value) with severe hyperkalaemia (potassium concentration >8 mmol/l).[109]

❖ **Urinalysis** Haematuria, proteinuria and glucosuria are typical findings. USG and pH will vary between cases. Urine sediment examination may reveal pyuria, bacteriuria, crystalluria and/or urinary casts. Bacterial culture is indicated if bacteriuria is present and clinical signs are consistent with UTI (see above).[111]

❖ **Abdominal radiography** Often a distended bladder is identified, but radiography may also detect underlying causes (eg, uroliths, urethral stricture). Radiography is reported to identify an underlying cause in 30–40% of cats with UO and is the initial imaging modality of choice, with retrograde urethrography (see Box 5) or ultrasound examination (see below) adding valuable information. Bladder and urethral stones can also be detected (see Figure 7).[112]

❖ **Ultrasonography** Uroliths, debris, bladder or urethral masses, and/or free fluid may be detected on ultrasound examination, although the pelvic urethra cannot be examined with ultrasound.

❖ **Electrocardiography** Even in the absence of bradycardia, electrocardiography is recommended. Changes on an electrocardiogram (ECG) associated with hyperkalaemia include a prolonged PR interval, decreased to absent P waves, widened QRS complexes, shortened QT intervals and tall tented or enlarged reversed T waves. With more severe hyperkalaemia, sinoventricular rhythm, atrial standstill, ventricular fibrillation and asystole can be seen. Although ECG findings roughly correlate with potassium concentration, there are many factors that impact cardiac function, and some cats may have potassium and calcium changes that are disproportionate to their ECG findings.

Initiation of fluid therapy should not be delayed until a urinary catheter is placed as fluid therapy will help to restore renal perfusion and reduce serum potassium.

Management

Fluid therapy

Intravenous (IV) fluids are needed to address dehydration and hypovolaemia, restore renal perfusion and correct hyperkalaemia. Initiation of fluid therapy should not be delayed until a urinary catheter is placed as fluid therapy will help to restore renal perfusion and reduce serum potassium. Crystalloid fluid choices include 0.9% saline or balanced isotonic fluids containing 4–5 mmol/l potassium. Evidence

Box 8

Point-of-care ultrasound for cats with urethral obstruction

Point-of-care ultrasound (POCUS) is extremely helpful for assessing patient volume status and fluid responsiveness,[115] and detecting early signs of fluid overload in cats with UO. Serial monitoring of the following parameters and signs is a rapid way to determine if a patient is developing fluid overload:

- Left atrial-to-aortic ratio
- Caudal vena cava (CVC)
- Left ventricular lumen size and wall thickness
- Cavitary effusion
- B-lines in the lung
- Gallbladder oedema

Assessment of the CVC and left atrium is particularly helpful as it can detect both volume depletion and volume overload. The CVC in cats is assessed at the subxiphoid window and will be collapsed or flat with volume depletion and distended with volume overload (Figure 17). Healthy cats should have a CVC change of at least 20% between inspiration and expiration, with the narrower measurement obtained on inspiration.[116,117] The CVC diameter should be interpreted with other clinical findings, particularly assessment of left atrial size as the left atrium tends to become smaller with volume depletion and enlarged with volume overload.[118] Serially tracking both the degree of change in CVC diameter with the respiratory cycle and echocardiographic volumes is particularly helpful. POCUS can also be used to examine the bladder, although the presence of fluid in the bladder does not exclude a tear or leak. For further discussion on the value of POCUS, readers are referred to 'Feline friendly POCUS: how to implement it into your daily practice' by Swanstein et al.[119]

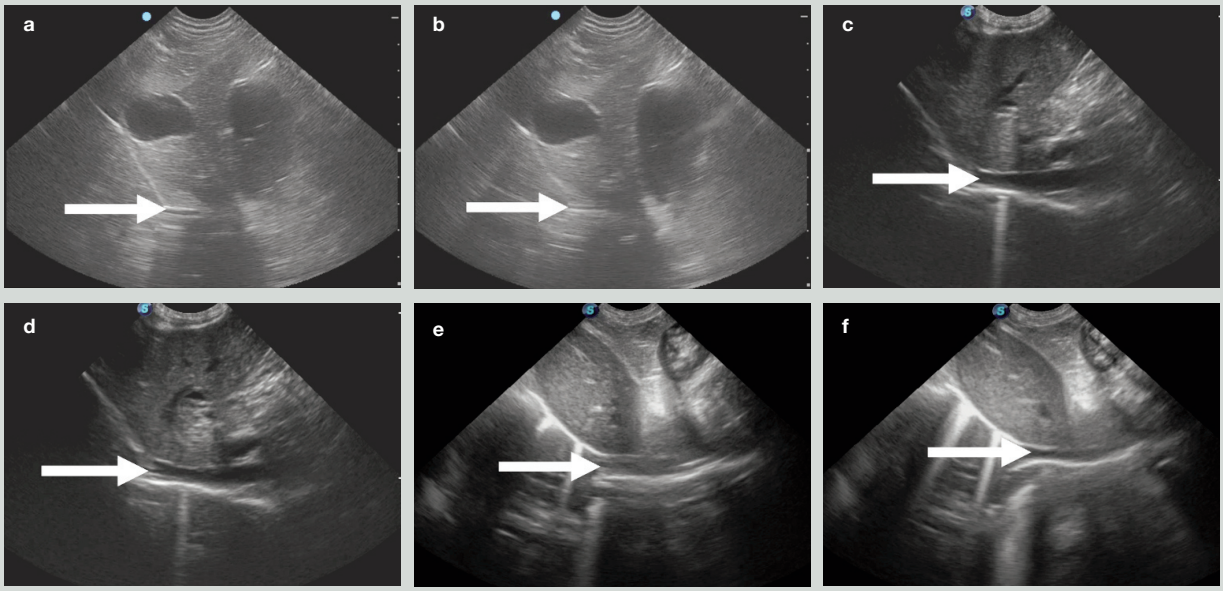


Figure 17 Ultrasound images demonstrating findings and changes relating to the caudal vena cava (CVC) in cats with differing volume status. (a,b) Hypovolaemic cats will have a flat/collapsed CVC (white arrows) that may or may not change between (a) expiration and (b) inspiration, depending on the severity of hypovolaemia. In this example the CVC does change significantly between expiration and inspiration. (c,d) Hypervolaemic cats will have a distended CVC (white arrows) that changes very little between (c) expiration and (d) inspiration. (e,f) Cats who are euvolaemic should have at least a 20% change in the diameter of the CVC between (e) expiration and (f) inspiration. In this example the change is around 40%. *Images courtesy of Søren Boysen*

suggests that balanced isotonic crystalloids may be preferable as they correct acidosis more rapidly, although fluid type (0.9% saline or balanced isotonic fluids) was shown to have no influence on normalisation of serum potassium.[113,114] Cats must be closely monitored with point-of-care ultrasound (POCUS; Box 8) for evidence of volume overload. Risk factors for fluid overload include administration of fluid boluses or the development of a heart murmur/gallop rhythm.[120] Volume overload during therapy for UO is associated with increased costs and a longer duration of hospitalisation (4.1 vs 1.8 days in one study[120]). Postobstructive diuresis (see later) is a common complication of UO.[121]

Where bolus fluid therapy is necessary (eg, in patients presenting in shock), a goal-oriented approach should be followed; for example, administration of a tailored 10 ml/kg IV isotonic crystalloid bolus over 10 mins, with reassessment of mentation, heart rate, pulse quality, mucous membrane colour, capillary refill time, blood pressure and POCUS findings until endpoints of resuscitation are achieved. Note that previously described high 'shock rates' of fluids are no longer recommended owing to the risk of fluid overload.[122]

Box 9

Should decompressive cystocentesis be performed in cats with urethral obstruction?

Decompressive cystocentesis can be considered for sedated/anaesthetised or collapsed cats if a urinary catheter cannot be passed and/or the patient is unstable with severe azotaemia and hyperkalaemia. Studies report a low risk of complications;[123,124] however, controversies remain, and arguments for and against decompressive cystocentesis are summarised below.

Arguments for
- Achieves immediate emptying of the urinary bladder
- Relieves bladder pain
- Facilitates retrohydropropulsion of obstructive material
- Decreases intraluminal pressure to aid passage of a urinary catheter
- Enables an uncontaminated sample to be obtained for urinalysis and culture

Arguments against
- Carries a risk of iatrogenic trauma to the urinary bladder wall, potentially leading to rupture and uroabdomen
- May not ease the process of, or reduce the time involved in, placing a urinary catheter[120]
- May delay placement of a urinary catheter

If performing decompressive cystocentesis, the risk of iatrogenic bladder damage can be reduced by involving adequate personnel: one person to insert the needle/butterfly catheter (plus three-way tap, if needed), and one to aspirate and *completely* empty the bladder. POCUS scanning of the abdomen before and after cystocentesis allows detection of increasing effusion levels (cats with UO may have pre-existing small effusions).[124]

Decompressive cystocentesis

Decompressive cystocentesis is controversial. Box 9 summarises pros and cons of the technique and provides some brief practical guidance for reducing risks.

Management of hyperkalaemia

IV fluid therapy is the fastest way to decrease potassium concentrations, and should be initiated prior to unblocking the cat.[125,126] Figure 18 summarises the clinical approach and Table 2 includes dosages for adjunctive medications.

Calcium gluconate is the first-line medication to treat life-threatening hyperkalaemia with bradycardia. The rationale is that ionised hypocalcaemia is present in 75% of cats with UO and exacerbates the effects of hyperkalaemia. Increased severity of hypocalcaemia is correlated with more severe cardiovascular compromise and a poorer prognosis.[128] Calcium gluconate may stabilise patients long enough to relieve UO and/or allow other potassium-lowering therapies to take effect. During administration of calcium gluconate, the patient should be monitored for arrhythmias (ECG or heart auscultation). In the absence of ECG monitoring, therapy is generally indicated when the heart rate is below 160 bpm.

Analgesia

The provision of analgesia is a priority. UO is a painful condition and, moreover, management of pain can reduce urethral spasm in some cats, resulting in spontaneous urination.[125] Use of a pure opioid will allow titration of the dosage to provide effective analgesia. Suitable options include methadone 0.2 mg/kg IV, a continuous rate infusion of fentanyl (3–20 μg/kg/h IV) or a fentanyl patch (taking into account delayed onset and variable efficacy).[129] Buprenorphine (0.02–0.04 mg/kg IV) could be used for less severe cases and for ongoing analgesia after catheterisation. The addition of meloxicam has not been shown to have any benefit in cats with UO,[130] and is generally not recommended in the initial management period. However, NSAIDs may be useful postobstruction if no contraindications remain present (eg, azotaemia or fluid deficits).[131]

A sacrococcygeal epidural (caudal epidural or coccygeal block; Box 10) with bupivacaine, lidocaine or a bupivacaine/morphine combination provides local analgesia to the perineum, tail, penis, urethra and anus. The technique can also reduce propofol requirements and has been shown to extend the time to rescue analgesia.[132,133]

Further details on analgesia can be found in the '2022 ISFM consensus guidelines on the management of acute pain in cats'.[129]

Sedation and anaesthesia for catheter placement

The choice of sedation vs general anaesthesia will be dictated by the patient's clinical status. Collapsed cats, for example, may be adequately sedated with a combination of an opioid (eg, methadone 0.2 mg/kg IV or IM) and midazolam (0.25 mg/kg IV or IM). Alternative combinations such as butorphanol 0.2 mg/kg IV and diazepam 0.2 mg/kg IV can be considered, being mindful that butorphanol will not provide adequate analgesia as a sole agent.[129] Ketamine (10 mg/kg IV) and diazepam (0.5 mg/kg IV) can also be titrated to effect, as needed.[103,125,134]

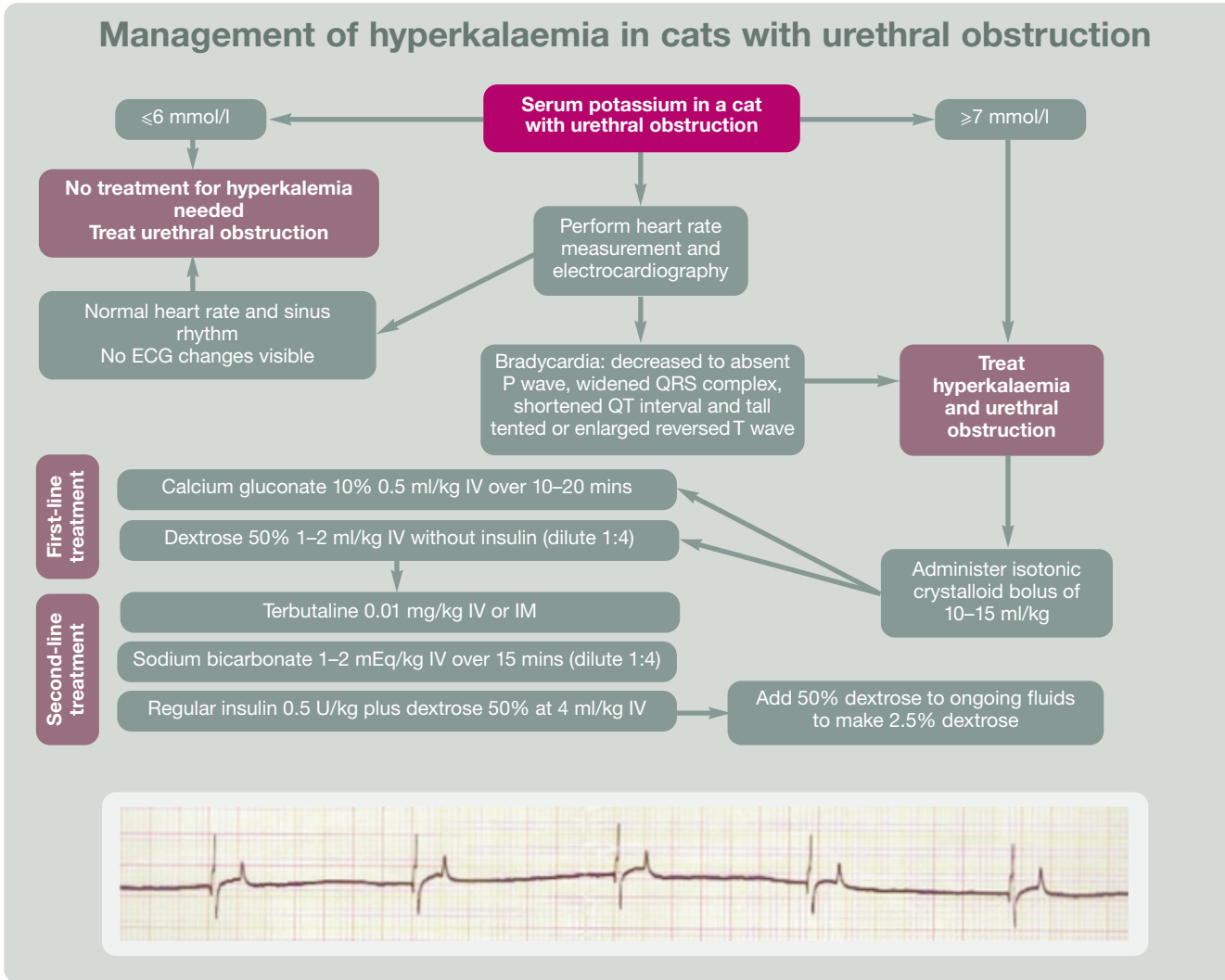


Figure 18 **Algorithm for the management of hyperkalaemia in cats with urethral obstruction. The inset box shows changes on an electrocardiogram (ECG) that are typical in cases of feline hyperkalaemia, including decreased to absent P waves, widened QRS complexes, shortened QT intervals and tall tented or enlarged reversed T waves. IM = intramuscularly; IV = intravenously.** *ECG image courtesy of Samantha Taylor*

Table 2 **Management of hyperkalaemia in cats with urethral obstruction (in addition to intravenous fluid therapy*)**

	Dosage	Notes
Calcium gluconate 10% solution	5 mg/kg of elemental calcium (approximately 0.5–1.5 ml/kg) given intravenously over 10–20 mins	❖ Produces decreased cardiac membrane excitability for approximately 20–30 mins
Dextrose 50% solution	1 ml/kg (0.5 g/kg) diluted 1:4 in 0.9% sodium chloride	❖ Dextrose stimulates endogenous insulin, driving potassium into cells
Neutral insulin with dextrose	0.2–0.5 U/kg of regular insulin IV with 2 g dextrose/unit of insulin	❖ Monitoring of blood glucose is needed for up to 24 h after insulin administration ❖ 2.5% dextrose CRI may be required for 6–12 h
Terbutaline	0.01 mg/kg slow IV or IM	❖ Stimulates Na^+-K^+-ATPase on cell membranes ❖ May cause tachycardia (and resultant hypotension if severe)
Inhaled albuterol/ salbutamol	Three to four puffs per cat, 100 µg/actuation	❖ Causes intracellular shift of serum potassium ❖ Inhaled salbutamol has been evaluated in dogs.[127] Dose-dependent reduction in potassium within 30 mins and nadir within 60 mins ❖ Safe and easy to administer
Sodium bicarbonate	1–2 mEq/kg IV over 15 mins	❖ The 8.4% solution (1 mEq/ml) is hyperosmolar and should be diluted ❖ May cause side effects such as decreased cardiac contractility and paradoxical CNS acidosis

*Intravenous fluids (see text) are the mainstay therapy for management of hyperkalaemia
CNS = central nervous system; CRI = continuous rate infusion; IV = intravenously; IM = intramuscularly

Box 10

Sacrococcygeal epidural

The technique is simple to perform (Figure 19) and should be considered for all cats with UO to provide analgesia to the perineum, tail, penis, urethra and anus, and facilitate urethral catheterisation (see video in the supplementary material).

Clip and surgically prepare three to four vertebral spaces cranial to the tail base. The sacrococcygeal epidural space can be identified by palpation as the most mobile joint caudal to the sacrum. Flex the tail dorsally to the point of maximum flexion and insert a 25 G needle with 1 ml syringe attached into the space with the bevel facing the tail at a 30–45° angle. Advance the needle (a pop can be felt as the needle passes through the ligamentum flavum). Gently aspirate to check for blood and then slowly inject the local anaesthetic(s). Bupivacaine (0.22 mg/kg) ± morphine (0.1 mg/kg) is used to provide 4–12 h analgesia; 0.1–0.2 ml/kg lidocaine 2% provides 1–2 h analgesia.

Complications are very uncommon but can include failure of sufficient analgesia, infection or abscessation. The risk of systemic absorption of lidocaine is less likely, as the dosage used is lower than IV dosages.

Figure 19 Sacrococcygeal epidural administration of local anaesthetics can provide an adequate means of pain management in cats with urethral obstruction. Leakage of spinal fluid is less likely at this location but can occur, as shown in this image. *Image courtesy of Paulo Steagall*

Provision of analgesia is a priority for cats with urethral obstruction.

However, most cats with UO will require general anaesthesia to ensure relaxation of the urethra and avoidance of pain and stress, although one recent study documented no difference between sedation and anaesthesia in terms of success of catheterisation or recurrence of UO.[134] Bradycardia, hypotension and hypovolaemia should be corrected prior to general anaesthesia. Further details on anaesthetic agents can be found in the 'AAFP feline anesthesia guidelines'.[135]

Antispasmodic therapy

Studies on the use of antispasmodic therapy to relax smooth and skeletal muscle in the urethra of cats with UO have produced conflicting results. Both phenoxybenzamine (2.5–7.5 mg/cat PO q8–12h) and prazosin (0.25–0.5 mg/cat PO q24h) are alpha-1 antagonists that induce smooth muscle relaxation. Prazosin was not shown to reduce the recurrence of UO in more recent studies,[136–138] despite earlier work suggesting efficacy[139] and benefit over phenoxybenzamine,[140] with the latter medication taking up to a week to become effective. Based on current evidence, administration of prazosin is not generally recommended. However, further work is needed to see if subsets of cats with UO may benefit, as studies varied with respect to dosage and duration of therapy, and lack of weaning before drug withdrawal may have resulted in rebound spasm. If used, initiation of alpha-1 antagonists should be postponed until fluid deficits and azotaemia are corrected, as hypotension is a potential adverse effect. Similarly, there is little evidence for the efficacy of acepromazine as a urethral muscle relaxant, and the resulting hypotension could reduce renal blood flow.

Skeletal muscle relaxants have been poorly studied in the management of UO. Dantrolene resulted in intraurethral muscle relaxation in a study measuring intraurethral pressure,[139] but can be challenging to dose orally due to patient size. Oral diazepam is associated with idiosyncratic hepatic necrosis and, hence, is not recommended. The benefit of IV diazepam as a skeletal muscle relaxant has not been studied but its usage could be considered as part of a multimodal anaesthesia regimen when catheterising cats with UO. Alprazolam has not been studied.

Urinary catheter selection

✣ **For unblocking** (see 'Urethral catheterisation technique for male cats'), an atraumatic, open-ended catheter is desirable. Most often polypropylene open-ended catheters (eg, Jackson, tomcat or Buster) and polytetrafluoroethylene or polyurethane catheters (Slippery Sam, KatKath), which may have a stylet and are less rigid than tomcat catheters (Figure 23), are used. Occasionally an IV catheter (without stylet) (Figure 24) or lacrimal catheter is needed. Olive tip catheters can be used for unblocking obstructions in the distal penis. Stylets should always be removed before catheterisation to avoid iatrogenic urethral trauma.

✣ **For indwelling use**, a closed-ended catheter of adequate length (14 cm or longer

Urethral catheterisation technique for male cats

As cats with UO may be unstable and are managed as an emergency, clinicians should prepare all equipment (see 'Required materials') prior to sedation/anaesthesia to expedite catheterisation and recovery.

- Once anaesthetised (most cases) or heavily sedated, the cat should be placed in dorsal or lateral recumbency. The hindlimbs can be drawn forward (with the help of an assistant or ties) to provide better exposure of the preputial area.
- A wide, careful clip to encompass the perineum is recommended to minimise bacterial contamination, taking care to avoid traumatising the area and causing irritation. This is followed by aseptic preparation of the site using a suitable disinfectant (chlorhexidine or povidone–iodine) diluted appropriately.
- Rectal examination should be performed to evaluate the intrapelvic urethra for uroliths/plugs.
- Reflect the preputial sheath from the penis to expose the urethral orifice and wipe the tip of the penis gently with a disinfectant safe for mucous membranes (eg, chlorhexidine).
- Massage the tip of the penis gently to dislodge plugs and clear debris, if present (Figure 20).
- Extrude the penis and gently pinch the prepuce, carefully pulling the penis dorsally and caudally until it is parallel with the spine (to straighten the 'S' shape of the ischial urethra; Figure 21). Failure to straighten the urethra will often result in failed attempts to unblock the cat and contribute to urethral trauma.

Figure 20 **Gentle massage of the tip of the penis to remove urethral plugs and distal uroliths.** *Image courtesy of Rachel Korman*

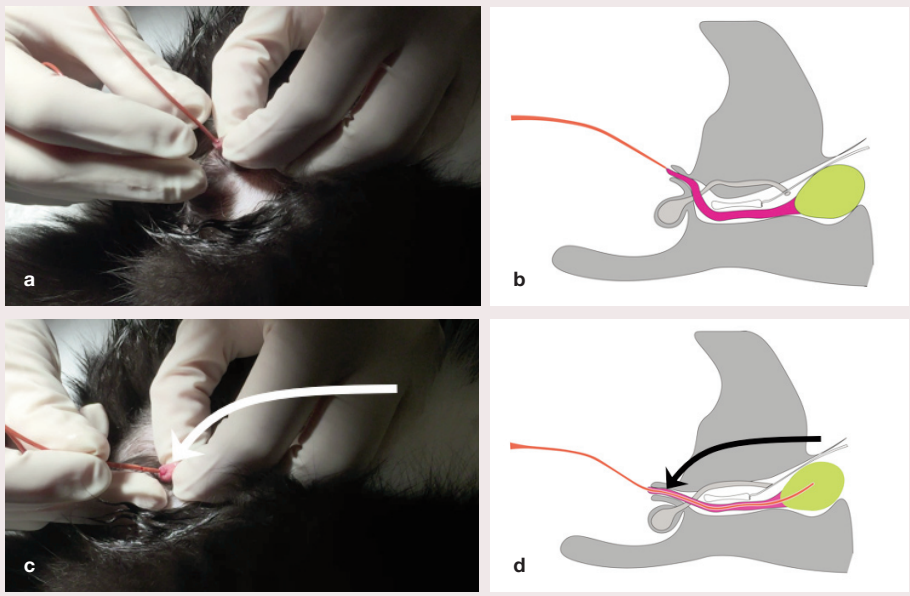


Figure 21 **(a–d) Photographs and accompanying diagrams to illustrate the importance of moving the penis (and thus urethra) dorsally and caudally to straighten the naturally occurring 'S' bend in the urethra (a,b) and allow passage of the catheter (c,d). This is performed by gently moving the prepuce (arrow).** *Images courtesy of Søren Boysen*

Required materials

- Clean sharp clippers
- Sterile gloves and surgical disinfectant, with swabs ± fenestrated drape
- Sterile lubricant
- IV catheter and IV fluids
- Two urinary catheters (one to unblock the patient and a second for longer term placement)
- Sterile closed urinary collection system
- Sterile saline to flush and help relieve the obstruction
- 20 ml or 30 ml syringes for flushing the bladder; smaller (2 ml or 5 ml) syringes for flushing the urethra
- Sterile tubes for submission of urine samples and uroliths/plugs (and, if indicated, urine for culture)
- Receptacle to collect urine once the patient is unblocked, as well as flush solution
- IV extension set with three-way stopcock
- Suture material and suture kit for securing the catheter

(Continued on next page)

[adjustable] for larger cats), with a softer texture and side holes, can be selected – such as a KatKath (Vygon Vet), EASYGO adjustable tomcat catheter (Mila International), Kittycath (Millpledge) or a red rubber catheter (product name, availability and manufacturer details vary between countries). Slippery Sam catheters are used as indwelling open-ended catheters, but there is a possibility of the catheter becoming disconnected from the hub and migrating into the proximal urethra/bladder. Published evidence supports the fact that smaller diameter catheters (3–3.5 Fr) are less likely to cause urethral trauma and may decrease the risk of UO recurrence.[140,144] Larger (5 Fr) catheters are generally avoided. In large cats, the required length (estimated by measuring from prepuce to bladder neck on a radiograph) may influence the choice of catheter.

(continued from previous page)

- The catheter used to unblock the cat should be lubricated with sterile lubricant (with or without added lidocaine, considering the total dosage of lidocaine to avoid toxicity). Attach a 10 ml or 20 ml syringe filled with sterile saline directly to the catheter or to a preflushed extension set (this allows for better manoeuvrability, Figure 22). Some authors use cooled saline but the benefit has not been studied. Injection of saline is used to create small bursts of pressure within the urethra to dislodge and retropulse the obstructive material into the bladder lumen.

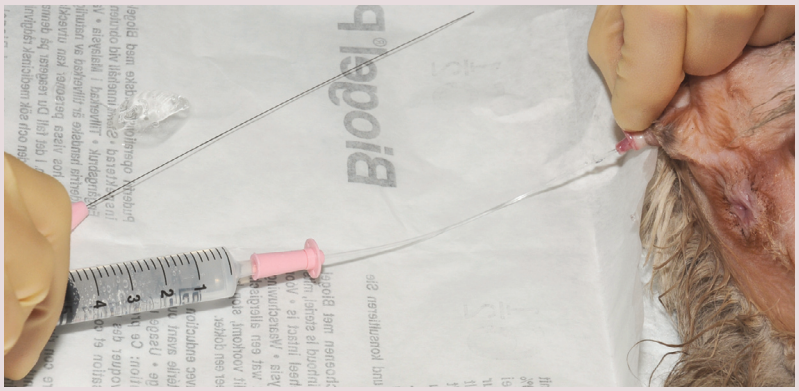
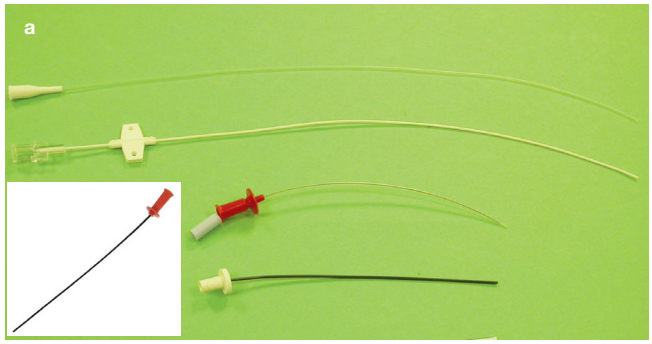
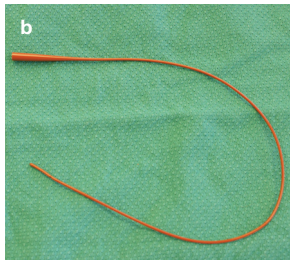


Figure 22 **A lubricated tomcat catheter with attached syringe of saline is inserted into the cleansed urethral orifice of an obstructed cat. Using pulsatile flushes, the catheter is slowly advanced.** *Image courtesy of Rachel Korman*

- While flushing, slowly and gently advance the catheter. If the obstruction is difficult to relieve with flushing and advancement of the catheter, attempt to occlude the urethra around the catheter (by gently pinching it between the fingers) to dilate it; the larger diameter may help with dislodging the obstruction. To avoid iatrogenic damage, never force the catheter cranially if resistance is encountered.
- If meeting resistance, reorient the penis from caudal to ventral (to straighten the 'S' shape slightly more ventrally) and try again to gradually advance the catheter. Gentle slow short back-and-forth movements with pulsatile flushing and straightening of the urethra will facilitate navigation of the curvatures.
- Once the obstruction is relieved, advance the same catheter (unless using an olive tip catheter) into the bladder lumen. Urine should be visible flowing from the catheter tip if the syringe is removed. Collect a sample for urinalysis.
- Drain the bladder to remove debris. One study showed that bladder lavage had no significant impact on the recurrence of obstruction,[141] although removal of visible debris, blood and crystals by flushing is recommended by some authors,[142] including the authors of these Guidelines. If performing bladder lavage, use warm sterile saline and ensure frequent palpation of the bladder to avoid overdistension.
- Intravesical instillation of caustic solutions is not appropriate. Instillation of lidocaine,[143] pentosan polysulfate[45] or glycosaminoglycans[47] into the bladder has also not been shown to provide significant benefit.
- Remove the catheter and place an indwelling catheter, if appropriate (see 'Indwelling catheter technique in male cats').
- Keep accurate records of findings (eg, presence of gritty material) and ease of catheterisation. Use of a scale can be helpful (1= easy to pass, 3 = very difficult); this will assist future management, and is particularly useful for staff taking over case management.





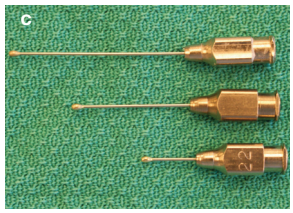


Figure 23 **(a; top to bottom) Polypropylene catheter, polypropylene catheter with adjustable suture wings, Jackson cat catheter with stylet, polytetrafluoroethylene catheter, and (insert) polytetrafluoroethylene catheter used both for unblocking and as an indwelling catheter. (b) Polyvinyl catheter. (c) Olive tip catheters.** *Images courtesy of (a) Danièlle Gunn-Moore and (b,c) Serge Chalhoub*

Figure 24 **An intravenous catheter (with stylet removed) can be useful for flushing the distal urethra.** *Image courtesy of Rachel Korman*

Maintenance of the urine collection system

Closed urine collection systems should be used, to prevent ascending iatrogenic infection and allow measurement of urine output. Commercially available sterile collection bags and connecting lines are preferred, but empty (ideally sterilised) IV (non-dextrose) fluid bags can be a cost-effective alternative. Urine collection systems should be changed every 2 days to avoid the risk of nosocomial infection and handled with gloves (sterile if also handling the catheter). The collection bag should be positioned below the level of the bladder to allow gravitational drainage, but kept off the floor for hygiene reasons (Figure 29). The entire collection line and the junction

Indwelling catheter technique in male cats

- Follow the above-described 'Urethral catheterisation technique for male cats' for guidance on insertion of a urinary catheter. A syringe and sterile saline flush is often required to distend the urethra during gentle passage of the indwelling urinary catheter.
- Catheter advancement should stop as soon as urine can be retrieved from the catheter. POCUS or radiography can be used to confirm the tip of the urinary catheter is situated within the urinary bladder, as positioning in the proximal urethra can cause irritation and failure to drain the bladder. Conversely, excessive length in the bladder risks catheter knotting.
- Red rubber indwelling urinary catheters can be fixed in place using butterfly tape sutured directly to the cat or using stay sutures as described in the next bullet point (Figure 25a). Other catheter types can be secured with sutures on the prepuce or perineal area (Figure 25b); avoid overtightening. The advantage of stay sutures is that they allow easier replacement of the urinary catheter, if required, without having to pass a needle through the prepuce.
- For the 'earring method', a stay suture is placed on each side of the perineal area. A simple interrupted suture is passed through the butterfly tape and then through each previously placed stay suture to secure it to the butterfly tape. Care should be taken not to overtighten these sutures as this can result in the tape causing irritation and discomfort to the prepuce. A finger trap suture can be added to further secure the catheter to the tape (Figure 26); again avoid overtightening, which will cause narrowing of the catheter lumen.

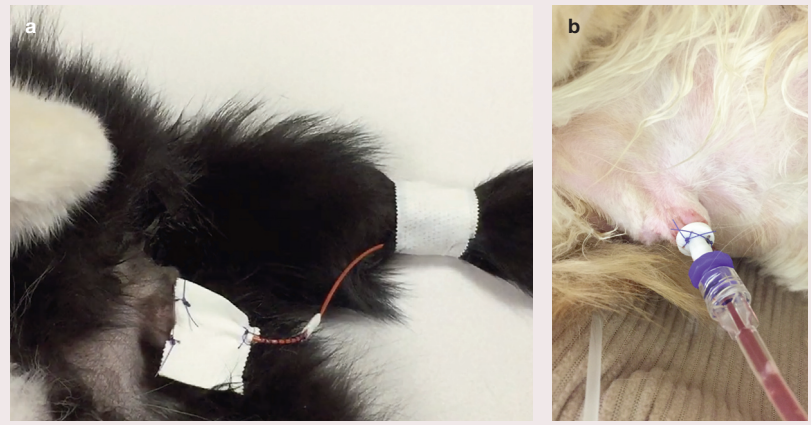


Figure 25 **(a) A red rubber catheter that has been advanced into the urinary bladder. Two stay sutures have been placed, one on each side of the perineum ('earring method'), and butterfly tape has been used to fix the catheter to the stay sutures. Two simple interrupted sutures secure the tape to the stay sutures. (b) An alternative method for securing a urinary catheter. In this case a 'Slippery Sam'-type catheter is secured with sutures to the prepuce and connected to a closed urine collection set using a 'Little Herbert' Luer lock connector. See text for discussion regarding choice of indwelling catheter.** *Images courtesy of (a) Serge Chalhoub and (b) Rachel Korman*

Figure 26 **Finger trap suture on a red rubber urinary catheter. The suture was started at the butterfly tape end, and continued downwards along the catheter for about 1–2 cm.** *Image courtesy Chantal McMillan*

- The catheter can be taped to the tail to avoid tension on the prepuce. There should be sufficient loose catheter between the tape and prepuce to ensure the catheter does not become dislodged by tail movement (Figure 27). Some catheters are designed to allow the collection tubing to 'swivel' and some collection bags have 360° spinners to help prevent knotting or traction on the prepuce (eg, Mila Closed Urine Collection System) (Figure 28).
- Attach the catheter to a closed urinary collection system and place an Elizabethan collar to prevent patient interference.

Figure 27 **Urinary catheters (red rubber [a] and Mila [b]), each attached to a closed urinary collection system, have been secured to the cat's tail to avoid tension on the prepuce.** *Images courtesy of (a) Chantal McMillan and (b) Laura Jones*

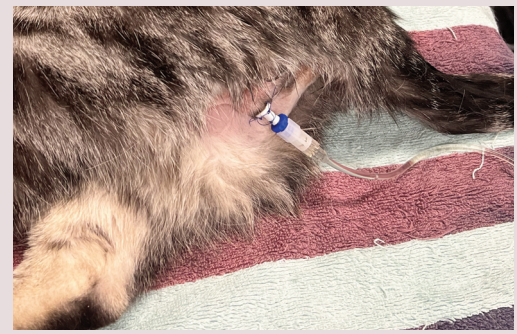


Figure 28 **An indwelling catheter connected to the collection tubing with a swivel device, allowing the tubing to twist and avoid traction on the prepuce.** *Image courtesy of Rachel Korman*

Indwelling catheter vs outpatient management

General advice and published evidence suggests that leaving a catheter in situ is optimal to minimise the recurrence of UO.[145] The recommended urethral catheterisation time is 24–36 h, although azotaemic cats need a longer (often >48 h) duration of catheterisation while on supportive therapy and IV fluids, depending on the severity and response.[140,141,144] However, if the catheter was easy to place without resistance, the cat is not azotaemic and other factors influence decision-making (caregiver finances, patient demeanour, hospitalisation facilities), then immediate removal of the catheter, analgesia and discharge can be considered. In one (potentially underpowered) study, the recurrence rate with this approach was 31%, indicating that most cats recovered, although this recurrence rate was higher than for hospitalised cats with indwelling catheters (11%).[145]

between the catheter and prepuce (or vagina) should be wiped with 0.05% chlorhexidine every 8 h or whenever contamination is seen. The following should be monitored:

- **Urine production** Empty the bag every 4 h and calculate urine volume produced (ml/kg/h). Comparison of fluid given ('ins') and urine produced ('outs') will ensure that the IV fluid rate is adequate and that the urinary catheter is patent;
- **USG** Measure every 4 h to ensure urine is dilute and the IV fluid rate adequate.

Hospitalisation of the obstructed cat

Cats with LUT disease and UO are painful and likely to be anxious. A cat friendly veterinary environment is vital to reduce stress and optimise recovery, and should incorporate: a cat-only ward (if not available, cats could be hospitalised in a cage in another room away from dogs); opportunities to hide, both within the examination room and within the hospital cage (hiding is a critical coping mechanism); and means of encouraging engaging emotions. An Elizabethan collar may be required to prevent patient interference with the urinary catheter but can result in stress and challenges accessing litter trays and hiding places. Large apertures to beds and supervised time without the collar is recommended. A fabric collar may suffice for some patients.

Further advice and discussion of cat friendly principles is provided within the '2022 ISFM/AAFP cat friendly veterinary environment guidelines'[146] and the 'Environmental modifications' section later. Importantly, cats may have litter substrate and litter tray preferences,[147,148] which are ideally replicated in the hospital; this may involve trialling soil or sand to imitate outdoor substrates.

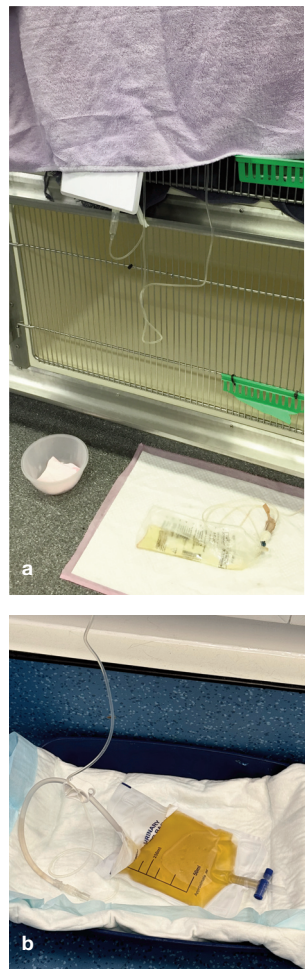


Figure 29 **(a) A sterilised intravenous drip bag is used as an economic closed collection system. Note it is not in direct contact with the floor and disinfectant is available to wipe connections clean when emptying or disconnecting the system. The cage front is covered with a towel to offer the cat a hiding opportunity. (b) A commercially available urine collection bag that allows easy measurement of urine output and is likewise kept off the floor.** *Images courtesy of (a) Rachel Korman and (b) Lumbry Park Veterinary Specialists*

Other considerations for the hospitalised cat are outlined below.

- **Ongoing analgesia**, preferably multimodal (eg, an opioid and NSAID, if no contraindication exists), must be provided.
- **Use of anxiolytics** such as gabapentin (5–10 mg/kg q8–12h) or pregabalin (used at 5 mg/kg for stress of veterinary visits,[149] with 1–3 mg/kg q8–12 h for neuropathic pain[150]) may improve tolerance of the catheter and provide analgesia. Note that gabapentin and other anxiolytic medications have not been studied for this indication.
- **Antiemetics** (eg, maropitant) and **appetite stimulants** (eg, mirtazapine) may be beneficial adjunctive treatments in cats with UO to encourage adequate voluntary food intake. Further information, including recommended dosages, is available in the '2022 ISFM consensus guidelines on management of the inappetent hospitalised cat'.[151]
- **Other treatments** will depend on the individual case.
- **Minimising the volume of blood collected for monitoring** is advisable. Anaemia is reportedly uncommon with UO but is associated with a poorer prognosis.[152] Anaemic cats (particularly those undergoing surgery) may benefit from blood transfusion.[153]

Medical management without catheterisation

A technique for management of UO without catheterisation has been described for cats with suspected urethral spasm (minimal biochemical derangements and normal abdominal radiographs).[154] The protocol involved: sedation with acepromazine (0.25 mg/cat IM or 2.5 mg/cat PO q8h) and buprenorphine (0.075 mg/cat IM q8h), with medetomidine given after 24 h (0.1 mg/cat IM q24h);

Cats with lower urinary tract disease and urethral obstruction are painful and likely to be anxious. A cat friendly veterinary environment is vital to reduce stress and optimise recovery.

massage to dislodge any obstructions in the distal penis; subcutaneous fluids; decompressive cystocentesis; and use of a low-stress (darkened, low-traffic) environment. Spontaneous urination occurred in under 72 h in over 70% of cases. It is important to note that while this protocol is cost-effective, it would be unsuccessful in the face of ongoing physical obstruction (eg, urolithiasis), which cannot be ruled out without catheterisation and possibly retrograde urethrography.

Postobstructive diuresis

According to several studies, postobstructive diuresis – defined as urine output greater than 2 ml/kg/h – may potentially persist for up to 84 h after catheterisation.[107,121,155] The aetiopathogenesis is likely multifactorial, involving loss of osmotic solutes into the urine, accumulation of excess diuretic solutes (eg, urea) during the period of obstruction, reduced collecting duct responsiveness to antidiuretic hormone and a progressive reduction in medullary concentration gradient. Postobstructive diuresis is difficult to distinguish from diuresis associated with fluid therapy and, if not addressed, can cause dehydration and hypokalaemia. The authors of a retrospective analysis of 57 male cats with UO treated with an indwelling catheter reported that an increasing severity of azotaemia, hyperphosphataemia and hyperkalaemia, and a lower USG at presentation, were correlated with the presence and severity of postobstructive diuresis.[121] Matching 'ins' and 'outs' (fluid given and urine produced), monitoring and supplementing potassium, if required, and gradually reducing the rate of IV fluid supplementation can avoid complications.

Considerations if catheterisation is not achieved

In some cats with UO, placement of a urinary catheter is challenging or occasionally impossible. Potential causes and recommendations are listed in Table 3. Note that cystostomy tube placement may be successful for urinary diversion (Figure 30), but is associated with a relatively high (49%) rate of complications.[158] Distal obstructions may be managed with perineal urethrostomy, with a retrospective case series indicating a good prognosis,[159] although the risk of UTI is increased.[160] The procedure can be considered in recurrent cases (eg, with caregiver cost limitations) but, importantly, underlying disease such as FIC should still be addressed, as described, to manage ongoing bladder pathology.

In the event a catheter cannot be placed despite addressing potential causes, decompressive cystocentesis may be performed and advice sought from a specialist centre.

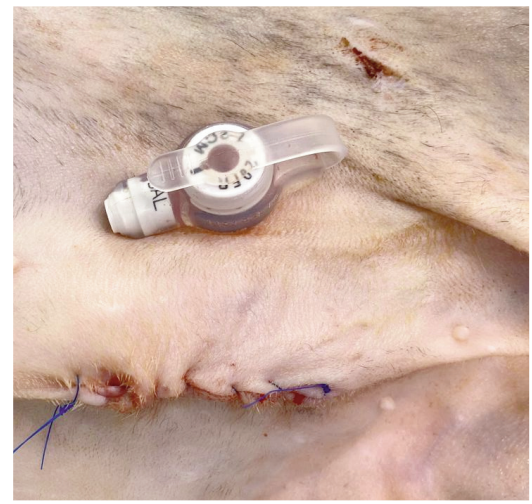


Figure 30 A cystostomy tube placed in a cat with a proximal urethral rupture to provide urinary diversion. *Image courtesy of Helen Kirkpatrick*

Table 3 Failure to pass a catheter in cats with urethral obstruction: causes and recommendations

Cause of failure of catheterisation	Actions
Urethra not straightened to align the perineal and pelvic urethra	❖ Flush catheter during advancement ❖ Perform rectal examination and retrograde urethrography to identify any anatomical obstructions or large uroliths ❖ Consider use of intraurethral atracurium besylate (neuromuscular blocking agent that causes skeletal muscle relaxation):[156] – 0.2 ml of atracurium (10 mg/ml) diluted in 3.8 ml of 0.9% NaCl = 0.5 mg/ml – Steadily instill into the urethral lumen over 5 mins – Gently pinch the urethral orifice with two fingers to prevent leakage ❖ Proceed with flushing and unblocking
Inadequate sedation or anaesthesia	Review depth of sedation/anaesthesia and consider additional anaesthesia/injectable agents
Inadequate analgesia	Review analgesia and consider a sacrococcygeal epidural (see Box 10)
Urethral rupture	❖ Perform retrograde urethrography to confirm patency of urethra ❖ Undertake conservative management or perform a urinary diversion procedure (cystostomy, perineal urethrostomy)*

*For more information, readers are referred to 'Urinary tract trauma in cats: stabilisation, diagnosis and management', by Robakiewicz and Halfacree[157]

Prophylactic antibiotic treatment of cats with indwelling urinary catheters is not recommended.

Appropriate use of antibiotics for cats with urethral obstruction

As discussed earlier (see 'Urinary tract infections and subclinical bacteriuria'), prophylactic antibiotic treatment of cats with indwelling urinary catheters is not recommended,[16] and culture of urine from the catheter or collection bag, or of the catheter itself when removed, may identify bacteriuria rather than a UTI.[161] Ideally, samples are obtained via cystocentesis if infection is suspected, taking into consideration that the bladder wall may be more friable given the recent UO.

Acquired bacteriuria in cats treated for UO with catheterisation was uncommon (13%) in one study,[162] and aseptic practices in placement and management of urinary catheters may minimise the risk of ascending infection. Catheters should not be left to drain 'open' without a collection system due to the high risk of infection. Catheters are usually in place for no longer than 24–36 h (unless the patient is azotaemic – see 'Indwelling catheter vs outpatient management'), which also reduces the risk of catheter-acquired infections. Clinical monitoring for signs of UTI (pyrexia, gross or cytological haematuria and pyuria) is recommended in catheterised patients, with removal of the catheter and quantitative culture of a cystocentesis sample performed if UTI is suspected.[16] Similarly, culture is recommended for cats with ongoing clinical signs after catheter removal.[17]

Complications

Complications of UO include bladder damage (with possible uroabdomen), iatrogenic urethral damage and tears, urethral stricture (usually within 3 months of a traumatic urethral catheterisation),[163] acute kidney injury, iatrogenic UTI, persistent LUTS, post-obstructive diuresis, hypokalaemia, dehydration and hypoperfusion. Trivial to small amounts of free abdominal fluid can be identified in cats with UO without evidence of urethral or bladder tears; however, only retrograde contrast studies can exclude these possible complications.[124]

Detrusor atony (overdistension of the bladder causing damage to tight junctions) is uncommon but can result in failure to urinate and retention of residual urine after voiding despite patency of the urethra.[164] Signs include severe overdistension of the bladder during UO, a flaccid bladder on palpation once obstruction is relieved, residual urine and urine leakage.[165] Return of normal detrusor function can be achieved by preventing detrusor stretch to allow re-establishment of tight junctions. This involves keeping the bladder small during the days immediately following relief of UO with an indwelling urinary catheter, and may take 7 days or longer.[166] Other causes of urinary retention (pain, urethral spasm, UTI) should be excluded. Bethanechol (1.25–5 mg/cat PO q12h) is a parasympathomimetic that may be used to augment detrusor contraction (only in cats with a patent urethra) and can be given with an alpha-1 antagonist.

If a cat fails to urinate after a urinary catheter is removed, recurrent obstruction is possible, but detrusor atony should be excluded and the stress of hospitalisation considered. For some cats, discharge into the home environment is preferable and normal urination will not be observed during hospitalisation.

If a cat fails to urinate after a urinary catheter is removed, recurrent obstruction is possible, but detrusor atony should be excluded and the stress of hospitalisation (unfamiliar environment, litter preference not addressed, cat usually urinates outside, etc) considered. For some cats, discharge into the home environment is preferable and normal urination will not be observed during hospitalisation.

Discharge post-urethral obstruction management

Ideally, cats are observed to urinate normally before discharge. However, there may be behavioural as well as medical reasons for failure to urinate (see above). At discharge, consideration should be given to how to provide ongoing analgesia for cats in a fashion that produces adequate pain relief, is easy for the caregiver to administer and has the least impact on interactions with the cat (eg, sublingual buprenorphine, oral NSAIDs and/or a fentanyl patch). Additionally, given the influence of stress on LUT diseases, caregivers should be advised on how to reintroduce the previously hospitalised cat to resident cats/pets to avoid frustration and redirected aggression. Examples include: initially confining the returning cat to one room and using a sock or glove to rub onto the cats' faces to allow mingling of scents; encouraging positive emotions; and allowing the level of arousal of all parties to reduce before reintroduction.[167] See 'Environmental and behavioural considerations for management of lower urinary tract diseases' for further recommendations on post-discharge management.

Prognosis

Reported survival rates to discharge for cats with UO managed using traditional protocols (indwelling catheter) are excellent (91–94%).[103,106,125] However, the long-term survival rate varies, with the same studies documenting rates of UO recurrence of 11–58% at various time points, leading to 21% of cats eventually being euthanased. Optimal post-discharge management and caregiver communication may improve such long-term outcomes.

Other lower urinary tract diseases

While FIC is the most common cause of LUTS, and urolithiasis another important cause, other conditions are reported, and it should not be assumed that repeat episodes have the same cause.[42] For example, a cat suffering episodes of FIC as a young adult could have urolithiasis or neoplasia when presenting with haematuria as a senior cat. In a study of bladder neoplasia in 118 cats, 78% had been evaluated previously for LUTS.[168] While the focus of this discussion is LUT pathology, upper urinary tract disease such as renal neoplasia, cysts, trauma and idiopathic renal haemorrhage can also result in haematuria.

Lower urinary tract neoplasia

Tumours anywhere in the urinary tract can result in clinical signs of haematuria, stranguria and dysuria, with the bladder being the most frequently affected location. Other clinical signs of LUT neoplasia may include lethargy, abdominal pain and vomiting.[168] Overall, tumours of the bladder are rare in cats,[169] with the most common being invasive UC (previously termed transitional cell carcinoma). Mesenchymal tumours, lymphoma and other tumours are less frequently diagnosed, either as primary neoplasms or as part of a multicentric disease process.[170–172] In contrast to dogs, where the trigone is most often affected, UCs tend to be found in more variable locations in cats (Figure 31), and urethral and ureter involvement is possible; the median age of affected cats in one study of 118 cases was 15 years.[168] A history of chronic FIC was reported in 3/11 cats with UC in one study.[173] Diagnosis can be made with imaging, urinalysis, fine-needle aspiration (noting there is a risk of tumour seeding), traumatic catheterisation, and cystoscopic, endoscopic or surgical biopsy.

The ability to palpate a urinary bladder does not rule out urinary tract trauma.

In contrast to dogs, where the trigone is most often affected, urothelial carcinomas tend to be found in more variable locations in cats.

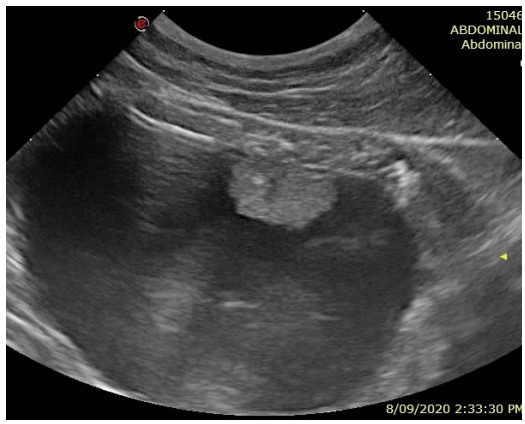


Figure 31 **Ultrasound image of a cat's bladder, showing a mass that was later confirmed to be an invasive urothelial carcinoma.** *Image courtesy of Rachel Korman*

Treatment of bladder UC in cats may include partial cystectomy, chemotherapy and/or radiotherapy.[168,174] In one study,[168] NSAID treatment with or without cystectomy was significantly associated with a longer survival time in cats with LUT UC; in another study, treatment with meloxicam alone was associated with a 1-year survival of 50% in 11 cats.[173] Median survival times with a variety of modalities are approximately 5–12 months.[168,172]

Urethral neoplasia is even less common and, as suggested, may develop as an extension of bladder neoplasia. It can be treated surgically; palliative stenting is also reported.[175] Prostatic neoplasia is also very rare in cats. Surgical treatment is likely the therapy of choice in most cases.[172]

Lower urinary tract trauma

Trauma to the urinary tract may occur as a result of external injury, principally from road traffic accidents, but can also be iatrogenic, associated with urinary catheter placement.[157] Signs can include haematuria and stranguria, and other injuries may also be present. The ability to palpate a urinary bladder does not rule out urinary tract trauma.[176] Also, abdominal effusions may not be obvious with intrapelvic urethral rupture as urine will accumulate subcutaneously.[177] Typical serum biochemical abnormalities include azotaemia and hyperkalaemia, and analysis of abdominal effusion (if present) may reveal an abdominal fluid to peripheral blood creatinine ratio ⩾2:1, which is predictive of uroabdomen.[178] Further diagnostic imaging, such as retrograde urethrocystography or contrast CT, may reveal the urinary rupture. For further discussion, readers are referred to 'Urinary tract trauma in cats: stabilisation, diagnosis and management' by Robakiewicz and Halfacree.[157]

Congenital lower urinary tract diseases

Congenital defects of the urinary tract are rare in cats, but can occur in all locations of the urinary system. Usually, they manifest at a young age, with LUTS and incontinence (Box 11). Such defects include abnormalities of the bladder (agenesis, hypoplasia, herniation),[181] urethra (ectopic ureters, aplasia, hypoplasia, duplication, prolapse),[181,182] urachus[183,184] and genitalia (fistulas, hypospadias).[185] Contrast radiography and advanced imaging may be useful for diagnosis, with treatment and prognosis depending on the specific abnormality.[181]

Box 11

Urinary incontinence in cats

Urinary incontinence is uncommon in cats and, when it occurs, is most frequently associated with spinal cord or urethral pathology. Incontinence can confuse the presentation of UO.[165,179] A full investigation is warranted in any cat presenting with urinary incontinence to determine the underlying cause, which may include:

- Partial UO (uroliths, stricture)
- Urge incontinence (bladder disease, FIC)
- Spinal cord disease (trauma, intervertebral disc disease, neoplasia)
- Urethral sphincter mechanism incontinence (congenital or acquired)
- Congenital disease (ectopic ureters [Figure 32], persistent urachus, bladder hypoplasia)
- Incontinence associated with feline leukaemia virus infection[180]
- Other, rare causes (vaginourethral fistula, prostatic disease)

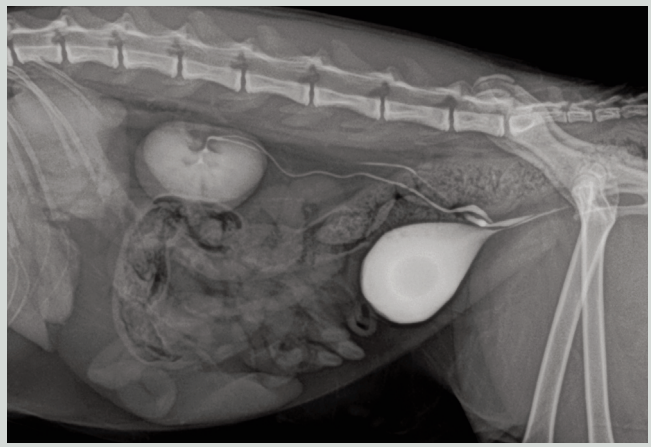


Figure 32 **Intravenous urography revealing ectopic ureters in a cat with incontinence.** *Image courtesy of Rachel Korman*

Other causes of lower urinary tract signs

Malakoplakia is a rare chronic inflammatory condition and is reported occasionally in cats.[186,187] LUTS are observed together with plaque or mass-like lesions in the urogenital tract that may be mistaken for neoplasia as the masses are composed of large round cells with granular cytoplasm. *E coli* infection may be involved in the pathogenesis and treatment with antibiotics can resolve lesions.

Environmental and behavioural considerations for management of lower urinary tract diseases

FIC is a threat-responsive disorder and MEMO has been shown to reduce its recurrence by lessening the cat's perception of threat and increasing their sense of control.[13] Moreover, other LUT diseases are also likely to benefit from efforts to address a cat's environmental needs by improving access to resources and reducing stress and anxiety.[188] For example, encouraging water intake and regular voiding will be beneficial for cats with urolithiasis, UTI and various causes of UO. Urination outside the litter tray, which may be a sequela of LUT disease, is also a common problem behaviour in cats, who may benefit from improvement in the home environment (Figure 33).[189,190] Cats suffering chronic pain for any reason can additionally benefit from species-specific improvement in the home environment.[131,191,192]

The below discussion focuses on pivotal aspects of MEMO and environmental resource provision/enrichment. Further insights into cats' environmental needs, and ways in which the veterinary team can help caregivers to accommodate them, are available in the 'AAFP and ISFM feline environmental needs guidelines'.[188]

Effective communication with caregivers of cats with lower urinary tract diseases is an important determinant of a successful outcome.

Caregiver role and communication

Caregivers play a key role in the management of most LUT diseases, and effective communication is vital to ensure adherence with recommendations and successful outcomes, particularly for cats with FIC,[37] but also potentially other LUT diseases. Caregivers may provide long histories, show frustration and have anxiety for the welfare of their pet. They may have used various forms of punishment with their cat, which will have done nothing to improve litter tray avoidance and will likely have increased the cat's stress.

'Caregiver burden' (the strain of providing care for an unwell pet)[193] is present in those caring for cats with LUT disease. In a recent survey of veterinarians in the USA, challenges with caregiver compliance and expectations were selected as barriers to achieving a posi-

Figure 33 **Urination outside the litter tray is a common problem behaviour that may or may not be due to lower urinary tract disease. Environmental changes are likely to be beneficial; for example, the litter tray in this image may be inadequate in size and an open tray could be trialled.** *Image courtesy of Rachel Korman*

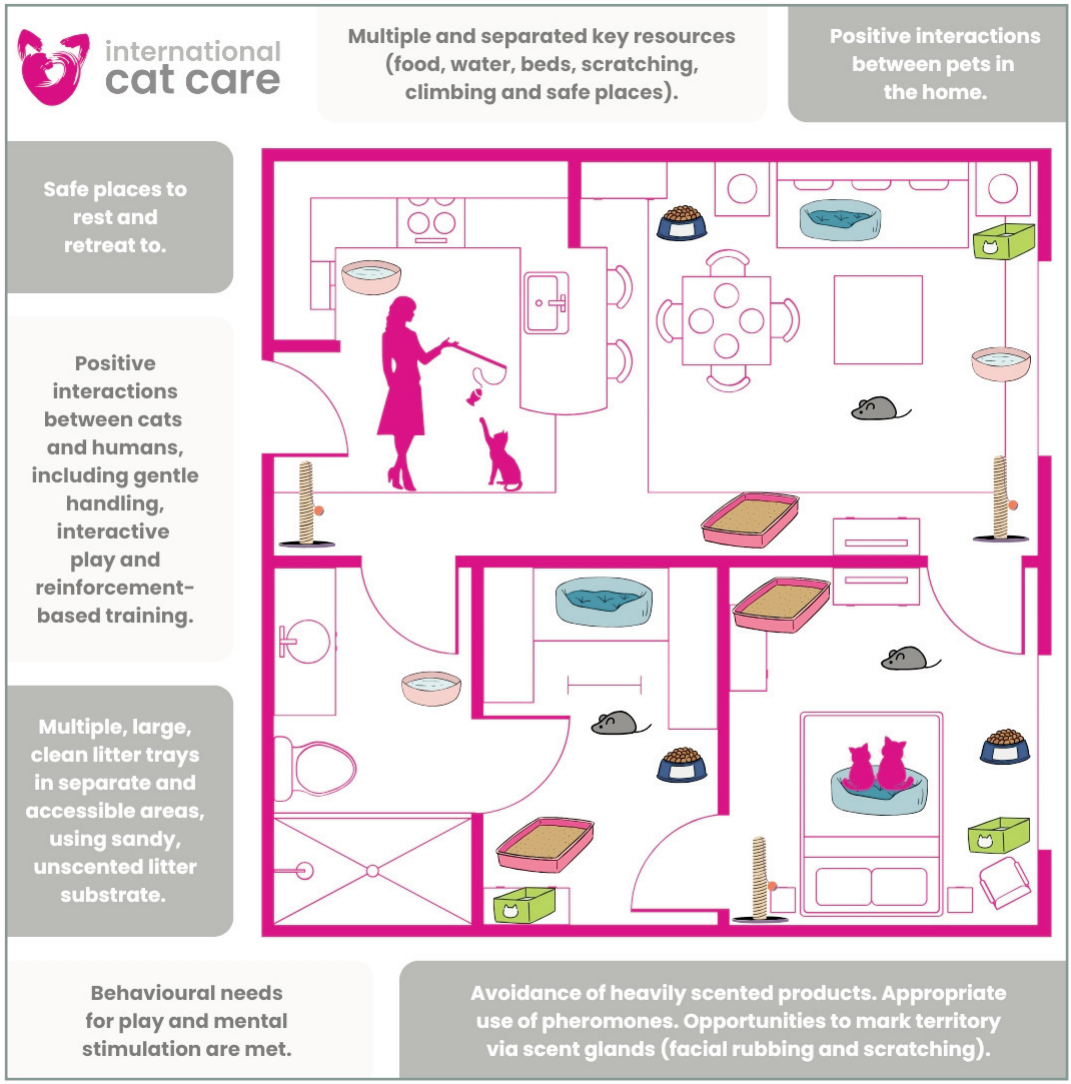
tive outcome in cases of FIC by 81% and 62% of respondents, respectively.[54] Therefore, an open, attentive, empathetic communication style, offering credible explanations for the cat's problems, likely improves outcomes, and involving the whole veterinary team will enhance the care of affected cats.[13,194] A questionnaire for caregivers of cats with LUTS, and a caregiver guide to caring for a cat with LUT diseases that aims to complement caregiver communication and improve understanding, are available in the supplementary material. Veterinary behaviourists and qualified consultants can also serve an important role in helping improve the cat's environment and litter tray usage.

Caregiver burden can be heightened by the requirement to administer medications,[195] which are commonly prescribed to cats with LUT diseases. Forced medicating can also cause stress to this vulnerable group of cats. Careful prescribing and adherence to the following advice can improve compliance:

- Prioritise the most important medications for cats who are hard to medicate.
- Give caregivers options as regards medication formulation (liquid, tablet, capsule), based on individual cat preferences and caregiver capabilities.
- Demonstrate how to medicate, or explain how to hide/crush medication in treats (preferable to build positive associations), providing appropriate resources (online or hard copy).
- Avoid hiding medication in main meals, as this can cause hyporexia (particularly with bitter medications).
- Follow up with caregivers after 24/48 h to discuss any challenges and offer alternative approaches.

Environmental modifications

Caregiver changes in the home can have a significant impact on LUT diseases. Aspects relating to a cat's environmental needs that should be discussed are summarised in Figure 34 and



Inadequate litter tray provision can result in urination outside the litter tray, less frequent urination and worsening of underlying lower urinary tract diseases.

Figure 34 Summary of areas of focus for caregivers of cats with lower urinary tract disease. *Adapted, with permission from Mikel Delgado*

Figure 35 Options to allow resting and perching in elevated locations should be provided. *Image courtesy of Mikel Delgado*

reviewed below. This may necessitate a longer consultation or a follow-up telephone call and caregivers should also be directed to appropriate sources of online and/or hard copy information.

Secure resting opportunities

A private, secure, raised resting area can give a cat a sense of seclusion and safety.[188] In multi-cat homes, there should be an adequate number of separated locations for all the cohabiting cats. Options include beds on shelves (Figure 35), hammock-style raised beds, beds designed with areas to hide and to perch, and scratching posts/trees with concealed resting areas; even simple cardboard boxes can suffice. For cats with mobility problems, steps or ramps should be provided to enable access to higher locations.

Litter tray management

Litter tray management should be explored with the caregiver, examining numbers and location of trays, litter substrate, cleaning regimen and so on. Inadequate litter tray provision can result in urination outside the litter tray and/or less frequent urination, with the cat retaining urine for longer than desirable. Key aspects of optimal litter tray provision include:

- Large enough trays for the size of the cat(s) (Figure 36).[196]

Figure 36 A large litter tray made from a storage box with soft litter. Several such resources, placed in quiet locations and scooped daily, can encourage use. *Image courtesy of Mikel Delgado*

- The option of 'open' or 'closed' trays, according to cat preference.[148]
- Easy entry (eg, lowered sides for cats with mobility problems), avoiding top-entering trays.
- Adequate numbers (one tray per cat plus one).
- Carefully selected locations. Trays should be located in quiet areas in the cat's main living space, with at least one on each storey of the house, away from food and water resources.
- Use of sandy, clumping-style litter (generally preferred by cats).
- Attention to tray cleanliness. Deposits should be regularly removed (at least once or, ideally, twice daily),[197] and trays should be completely emptied, cleaned with a mild detergent and rinsed with hot water every 1–2 weeks (sooner if soiled).

Cats with LUT diseases may suffer pain on urination and associate this with the litter tray. Offering an additional choice – in the form of a new tray in a different location with novel substrate – may be helpful in these instances; however, this should only be carried out once the cat's signs have resolved and any pain has been addressed. Cats with outdoor access can be provided with a 'latrine' area with a soft rakeable substrate (sand or soil) in a quiet part of the garden (Figure 37). Cats with outdoor access can also benefit from an indoor litter tray to use as needed (eg, in inclement weather).

Figure 37 Outdoor latrine in a quiet area with a rakeable surface to encourage regular voiding. *Image courtesy of Alex Taylor*

Food and water bowls

There are various means of encouraging water intake (Box 12), which is likely to benefit cats with all forms of LUT disease.[13,46] Caregivers can also be directed to International Cat Care's resource 'Encouraging your cat to drink: a guide for caregivers', available at icatcare.org/cat-advice/cat-carer-guides, for detailed information.

As with water sources, cats in multi-cat homes should be offered at least as many feeding stations/bowls as there are cats in the home. Food dishes should be positioned in quiet locations offering privacy, out of view of other cats.

Other resources

Options for vertical and horizontal scratching should be provided, ensuring adequate numbers in multi-cat homes; locating these resources close to sleeping areas and to the perimeter of the cat's territory, as well as in

Box 12

Increasing water intake in cats

Caregivers can be encouraged to:

- Provide water in several locations, both indoors and outdoors (if relevant)
- Offer different types of bowl to assess the cat's preference (wide-brimmed ceramic bowls are often preferred)
- Provide a water fountain or other source of moving water (cleaning and changing the filter regularly) (Figure 38)
- Raise water sources off the ground for cats with pain and/or mobility issues (eg, osteoarthritis)
- Change the water and clean bowls/fountains regularly (at least every other day)
- Avoid 'double bowls', where water is in close proximity to food and can easily become contaminated
- Position water bowls away from the wall to allow cats to face towards the room when drinking
- Feed a wet diet (if appropriate)
- Add a little water to wet food (only if this does not deter the cat from eating), or offer 'flavoured' water (cooking water from fish/chicken or liquidised food mixed with water)

Figure 38 **Water intake should be encouraged for cats with any type of lower urinary tract disease; for example, using a water fountain.** *Image courtesy of Rachel Korman*

areas where furniture has been scratched, will encourage use.[198] Climbing structures and self-play toys, along with puzzle feeders (Figure 39), can provide environmental enrichment.[199,200] For cats without outdoor access, a feline patio ('catio') or supervised outdoor exploration using a harness and lead may be considered; the latter option requires careful introduction and training (see go.jfms.com/training_harness).[201]

Figure 39 **Puzzle feeders can provide environmental enrichment and some types, such as the one pictured here, can be used with wet food for cats with lower urinary tract diseases.** *Image courtesy of Samantha Taylor*

Human–cat interactions

The aim in all interactions is to reduce the cat's protective emotions and encourage engaging emotions.

- Daily interactive playtime provides exercise, which may have anxiolytic effects.[188] Moreover, interactive playtime provides an outlet for species-typical behaviour (hunting) and may benefit the human–animal bond.[202]
- Positive reinforcement-based training can provide mental stimulation and positively impact the caregiver–cat relationship.[203,204] The aim may be to impart basic skills (eg, train the cat to go into their carrier or to accept grooming such as nail trims), encourage relaxation behaviours (eg, sit/stay), or simply have fun (parlour tricks such as 'high five').
- Grooming/brushing can likewise be a positive experience, if the cat enjoys it. Each cat's limits/preferences (eg, in regard to handling and petting) must always be respected.
- Avoidance of physical or other forms of punishment (eg, spanking, yelling, squirting with water bottles) is paramount. Punishment increases fear and stress and is not a humane or effective way to change behaviour.

Scent and pheromones

Cats are extremely scent-sensitive,[190] and pheromones play an important role in communication.[205] Feline synthetic pheromones have been shown to reduce anxiety,[206] scratching behaviour[207] and urine spraying.[208] An early pilot study evaluating facial pheromone fractions in cats with recurrent FIC found no significant decrease in the duration of clinical signs in the pheromone group, but there was a trend towards fewer episodes, shorter episode duration, and less aggression and fear behaviour.[209] Therefore, while not appropriate as a sole treatment, pheromone therapy may be useful as an adjunctive management tool for cats with FIC.

In addition, because the feline sense of smell is so highly sensitive, caregivers should avoid using heavily scented products in the cat's environment (eg, incense, scented candles, strong cleaning agents).

Intercat tension (inside and outside the home)

Intercat tension is common and may affect feline welfare.[201] Social tension between cats in multi-cat households, as well as tension involving cats outside the home, could

SUMMARY POINTS

- Dysuria, stranguria, periuria, pollakiuria and haematuria are clinical signs of LUT diseases and not diagnoses in themselves. Investigations are needed to determine the underlying cause. The most common LUT disease is FIC, but other conditions such as urolithiasis should be excluded in cats with LUTS.
- Urinalysis and imaging are particularly useful in the investigation of LUTS.
- FIC should be considered a systemic disorder involving organs in addition to the bladder. FIC affects susceptible cats living in provocative environments and is optimally managed using MEMO (multimodal environmental modification) including changes to the cat's environment to decrease activation of the central threat response system.
- Struvite and calcium oxalate (the most common uroliths) are usually sterile and may not always be associated with crystalluria of the same composition.
- UTI is a less common cause of LUTS, particularly in otherwise healthy adult cats, and the finding of subclinical bacteriuria does not warrant antibiotic treatment.
- UO is a life-threatening and painful complication of certain LUT diseases. Optimal management involves catheterisation, analgesia, investigation and treatment of the underlying cause, and appropriate follow-up care to avoid recurrence.
- An environment that is not meeting a cat's needs should be considered a risk factor for LUTS.
- A cat's relationships (with humans and/or other cats/animals inside or outside the home) can be a source of environmental stress and should be explored in patients exhibiting LUTS.

contribute to stress and trigger or exacerbate LUT diseases. The '2024 AAFP intercat tension guidelines: recognition, prevention and management'[201] describe interventions for addressing social tension or conflict among cats, based on a framework of 'five pillars of a healthy multi-cat environment'.

Conclusions

LUTS are a common reason for cats to be presented to the veterinary clinic. There are many underlying causes, the most common being FIC, followed by urolithiasis and UTI. These Guidelines refer to these as LUT diseases and have deliberately avoided the (outdated) term 'FLUTD', which is not a diagnosis in itself. The consequences of LUT diseases include UO, which can be life-threatening. Management of LUT diseases should involve a combination of medical, including analgesic (these are painful conditions), and behavioural interventions, recognising that FIC is the bladder's manifestation of a systemic disease.

Supplementary material

The following supplementary material files are available at go.jfms.com/LUTD_GLs_2025:

- Questionnaire for caregivers of cats with lower urinary tract signs.
- Video demonstrating the sacrococcygeal epidural (coccygeal block) technique in cats. *Courtesy of Rachel Korman, Veterinary Specialist Services and Cat Specialist Services.*
- Understanding urinary tract diseases and how to help cats at home: a guide for caregivers.

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ORCID iD

Samantha Taylor https://orcid.org/0000-0002-8668-0777

Søren Boysen https://orcid.org/0000-0002-0936-4834

Tony Buffington https://orcid.org/0000-0002-2759-6524

Serge Chalhoub https://orcid.org/0000-0002-0084-1446

Pieter Defauw https://orcid.org/0000-0002-5098-8411

Mikel M Delgado https://orcid.org/0000-0002-3252-2618

Danièlle Gunn-Moore https://orcid.org/0000-0003-2088-503X

Rachel Korman https://orcid.org/0009-0003-6745-5931

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