

# Urinary tract infection – a European perspective

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## INTRODUCTION

Urinary tract infection (UTI) refers to microbial colonization of any portion of the urinary system that is normally sterile. The distal urethra is not sterile, but has a normal flora.[3] UTIs are usually caused by bacterial organisms that are part of the microflora of the intestinal or the lower urogenital tract.[3] However, viruses and fungi may infect the urinary tract.[4] UTI appears to be less common in cats than in dogs.

This paper is based on a lecture given at the Hill's European Symposium on Advances in Feline Medicine\*

## Prevalence

The prevalence of feline UTIs has not been defined, but has been estimated to be in the range of 0.1 to one per cent, and at least 10 times less than the estimated prevalence in dogs.[15] It has been reported that one per cent of cats admitted to veterinary teaching hospitals were diagnosed with UTI, and in studies from the USA, the frequency of UTI as the cause of lower urinary tract disease (LUTD) in cats ranged from 1 per cent to 12 per cent.[1,6,12,14] In a recent two-year Swiss study of cats with LUTD, UTI was found to be the underlying cause in 8 per cent (FIGURE 1).[8] In another recent report from Norway the proportion of cats with UTI was somewhat higher, accounting for 18 per cent of the cats with LUTD.[16]

## Location And Host Defence

Infection can occur either in the upper or lower urinary tract or at both sites simultaneously. However, it can sometimes be difficult to detect the exact location of an infection.

Furthermore, an infection in one part of the urinary tract increases the likelihood of another part of the urinary tract to become infected as well.[3]

Involvement of the prostate in feline UTIs is rare.[23] Most UTIs are the result of ascending migration of pathogens from the distal urogenital tract to the sterile part, and the UTI develops

when the host's defences are overwhelmed by microbes.[4] Normal defences include wash-out of pathogens by normal micturition with complete emptying of the bladder, an intact mucosal layer with glycosaminoglycans, epithelial desquamation, functional properties like ureteral peristalsis and local and systemic immune competence. Furthermore urine itself has antimicrobial properties that may play a role in limiting bacterial growth including its high osmolality, and urine constituents with antimicrobial effects (e.g., high concentrations of urea, organic acids, Tamm-Horsfall mucoproteins or low-molecular weight carbohydrates) and extreme values of urine pH.[19,25]

## Organisms

Not all microbes are pathogenic. Bacteria need special virulent factors to initiate a UTI. In *Escherichia coli*, adhesins are the most firmly established virulent determinants, but typically there is more than one virulent factor, including resistance to serum bactericidal action, haemolytic activity, possession of certain O and K-antigens, iron-scavenging proteins and bacteriocins.[25] *Escherichia coli* and *Staphylococcus* spp. have been the most common organisms isolated from UTIs in the studies reported from cats. In one study, organisms responsible for feline UTIs were bacteria in 28 per cent and viruses in 0.4 per cent, with the causative agent not specified in the remainder.[14] Among the bacteria, *E. coli* was found in 46 per cent of the cases, *Staphylococcus* spp. in 9 per cent, *Streptococcus* spp. in 5 per cent, *Klebsiella* spp. in 3 per cent, *Proteus* spp. in 3 per cent and *Pseudomonas* spp. in 1 per cent. In 31 per cent the type of bacteria was not designated. The viruses involved were not

\* Brussels 26-28th April 2006

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The lecture on which this paper is based was given at the 10th Annual Hill's Symposium held in Brussels 26th -28th April 2006. Bernhard Gerber is an Assistant Professor for Small Animal Internal Medicine at the University of Zurich, Switzerland.

specified. Viruses have been considered as causative agents for feline LUTD for a long time.[17] Recently two novel feline calici viruses were isolated from urine of cats with naturally occurring LUTD, although the causative relationship to LUTD remains questionable.[22] In earlier studies, calici viruses, herpes viruses and feline syncytiumforming virus have been isolated from urine and tissues of cats with LUTD and suspected to be causative agents in the aetiopathogenesis of LUTD.[13] Although not yet proven, the viral hypothesis is supported by findings of virus-like particles tentatively identified as calici viruses in a substantial number of crystalline-matrix urethral plugs obtained from cats with obstructive LUTD.[17] Fungal UTI in cats is often associated with other forms of LUTD, and *Candida* spp. are the most commonly reported organisms.[10,21]

## Signalment

Older cats (10 years+) have an increased risk of acquiring bacterial UTI, while in cats less than one year old, the risk is minimal.[14] Furthermore, cats with UTI have been shown to be significantly older than cats with other forms of LUTD (i.e. five to 15 years, median 13 years).[8] The proportional morbidity rate of UTI also appears to increase with age, as reported by veterinary colleges in the USA.[17] UTI has been more often identified as a cause of LUTD in female cats than in male cats, and further analysis revealed that female spayed cats had an increased risk of bacterial UTI while female and male intact cats had a decreased risk.[14] In another study, there were also significantly more female cats in the group with UTI compared to other causes of LUTD such as uroliths, urethral plugs and idiopathic LUTD (FIGURE 2).[8] It has also been suggested that Abyssinian cats and overweight cats have an increased risk of UTI.[7]

However, in a Swiss study, none of the cats with UTI as a causative agent of LUTD were found to be overweight, while 12 per cent

Figure 1. Differential diagnosis of FLUTD – survey of 77 cats.

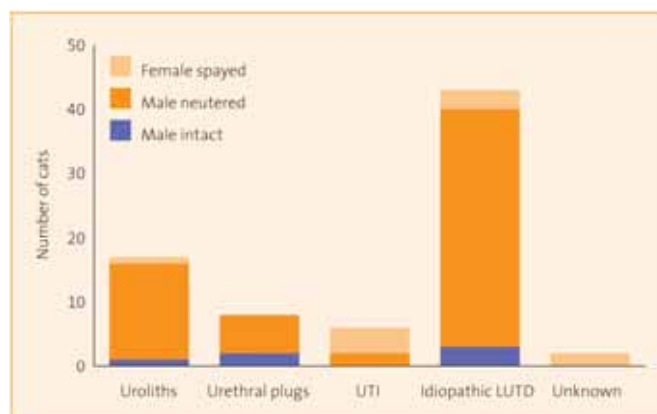
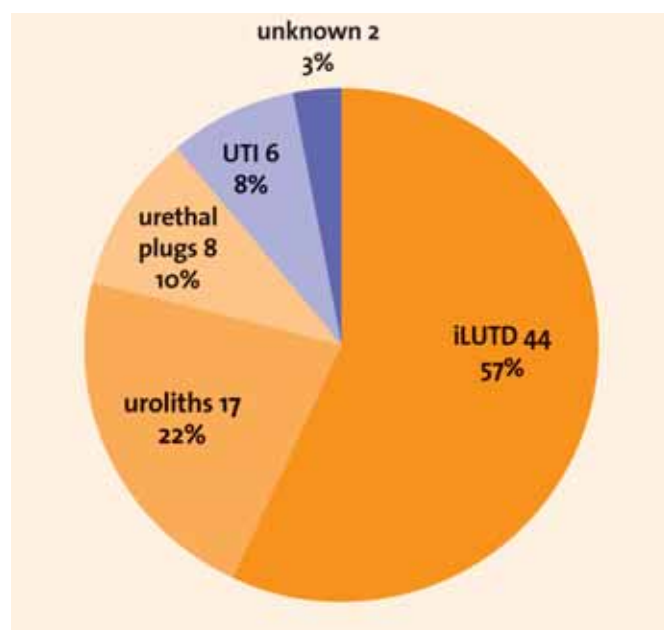


Figure 2. Gender of cats with different types of LUTD. (n = 77; 87 per cent of the cats were male.)

of cats with uroliths, 36 per cent of cats with idiopathic LUTD and 50 per cent of cats with urethral plugs were overweight.[8]

## Underlying conditions and predispositions

Underlying conditions can increase the risk of UTI in cats. In a study of diabetic cats, 10 per cent were reported to have UTI. All of them had clinical signs of diabetes mellitus for more than four weeks, and *E. coli*, *Serratia* spp. and a mixed population of microbes were found.[11] After obstructive LUTD, indwelling catheters with a closed system may be a cause of UTI.[2] However, treatment is not advisable while the catheter is in place, whereas urinalysis with culture and appropriate treatment at the time of removal of the catheter is recommended.[2] UTI is the most frequent late complication of perineal urethrostomy.[5]

## Clinical signs

The clinical signs of cats with lower urinary tract disease are relatively consistent regardless of the cause of the disease.[18] They consist of haematuria, pollakiuria, stranguria and urination in inappropriate places (also termed periuria) (TABLE 1). Urethral obstruction may or may not be present (FIGURE 3). Only one study has identified UTI as a primary cause of obstructive LUTD.[1] In other studies of cats with and without obstructive LUTD, those with UTI as the primary cause of the disease were not found to be obstructed.[8,12] Gross haematuria as a historical feature has been reported more frequently in cats diagnosed with UTI than those with other causes of LUTD (TABLE 1).[8]

## Diagnosis

The gold standard for diagnosis of UTI is urine culture. Examination of the urine sediment provides some help in the identification of UTI. More than four white blood cells per high power (x400) field in sediment examined under a cover slip, together with identification of bacteria, are indicative of UTI. However, the presence of pyuria alone simply reflects any inflammatory cause and is not synonymous with UTI. Equally, the absence of pyuria

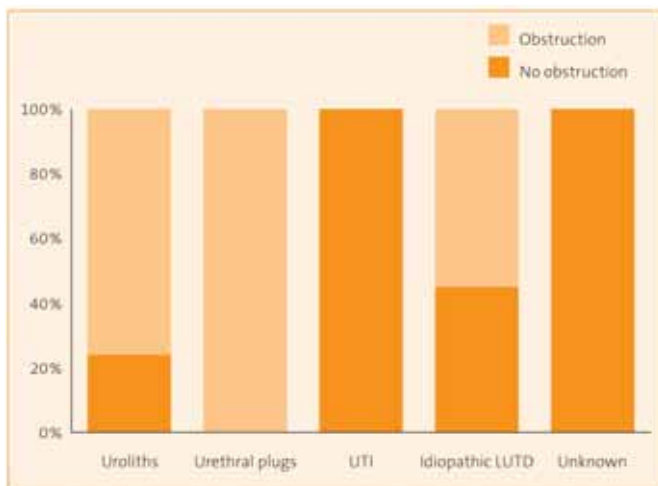
	Haematuria	Pollakiuria	Stranguria	Periuria	Pain
All cats	43	40	48	32	43
Cats with UTI	67	50	50	50	50

Table 1. Clinical signs in 77 cats with LUTD. Per cent of cats showing each of the clinical signs.

does not rule out a UTI. Rod shaped bacteria might be seen in the sediment if the concentration of bacteria in the urine is greater than 10,000/ml, although cocci may not be seen until the concentration reaches 100,000/ml. Care is needed though, as the presence of bacteria might represent contamination or amorphous particles resembling bacteria may be mistaken for true bacteriuria.

Microscopic examination of modified Wright's stained urine samples has been shown to be superior to traditional wet mounts when attempting to identify bacterial UTI in dogs. Urine collected for culture should be obtained by cystocentesis. In one study, while culture of urine was negative in 79 per cent of cystocentesis samples, it was only negative in 55 per cent of the same cats when collected by catheterization, and only negative in 17 per cent when voided urine samples were cultured.[18] Clipping and disinfection prior to cystocentesis have been shown to be unnecessary.[24] The definition of significant bacteriuria in cats seemingly involves lower numbers than in dogs when urine is collected by catheterization or free catch, which is attributed to a greater innate resistance of cats to UTI.[7,18,19] Proper handling of the urine after collection is very important and urine should ideally be cultured immediately after sampling because some bacteria may multiply very rapidly while others may decrease in number. Where immediate culture is not possible, boric acid-containing tubes seem to be adequate for urine storage at room temperature, at least in dogs, as culture results after storage in a boric acid-glycerol-sodium formate tube for up to 48 hours at 20°C correlated well with the immediate culture of the same urine.[20] Bacteriuria is considered significant (= UTI) if there are more than 1,000 colony forming units per millilitre of urine. Values below this or cultures with multiple types of bacteria must be assessed carefully because both can indicate contamination.

Figure 3. Presence of obstruction in cats with different types of LUTD.



## Therapy

Administration of antimicrobial agents should be based on susceptibility testing. Fortunately most antimicrobials are present in urine in high concentrations as a result of renal excretion, which means a good result can often be obtained in an animal even if an antibiotic is used to which the organism is reported to be resistant (because of the higher concentration in the urine). An antimicrobial is said to be effective (the organism is 'sensitive') if the urine concentration reaches four times the minimum inhibitory concentration (MIC). Empirical treatment is often necessary before culture and sensitivity results are available. Antibiotics are chosen based on urine sediment results (cocci or rods). Rods in acidic urine may represent *E. coli* while in alkaline urine they may represent *Proteus* spp. Cocci in acidic urine may represent *Enterococcus* spp. while in alkaline urine *Staphylococcus* spp. is more likely. Appropriate antibiotics should be given for two to three weeks in uncomplicated cases.[4] Special caution is needed with the use of fluoroquinolones because of the potential risk for retinal degeneration. As renal impairment is often associated with UTI, it is speculated that with decreased renal function fluoroquinolones may accumulate which would require dosage reduction and monitoring for mydriasis.[9,26]

## Prognosis

Approximately 85 per cent of UTI in cats are single episodes and do not recur.[15] Relapsing UTI might either be caused by the same organism which was isolated before treatment (persistent UTI) or by a different organism (recurrent UTI). In both cases a further workup is required to identify the underlying causes. If predisposing disorders are not addressed, control of UTI will be poor. Reasons for poor response to therapy might be treatment of a non-infectious problem with antibiotics, ineffectiveness of the antibiotics because of inadequate delivery (poor client compliance, poor patient acceptance, ineffective drug or impaired drug transport), resistant microbes or superinfection with another organism. For example, super infections can occur when antimicrobials are given while a urinary catheter is in place. Prophylactic antimicrobial therapy might be indicated after catheterization. Long-term lower dose therapy might be indicated if the patient experiences relapses each time antimicrobial therapy is stopped. This treatment strategy is not well studied in veterinary medicine. It has been suggested that half to a third of the usual therapeutic dose of an antimicrobial is given every evening for this purpose.[4] The choice of the antimicrobial is based on the last positive culture and the duration of therapy is at least six months. If adopting this approach, urinalysis and culture should be performed every four to eight weeks.

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