UTIs: MOLECULAR SCRUTINY. IS THERE ZOONOTIC POTENTIAL?

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Mention the word 'zoonosis' in the context of exposure to companion animal urine and most veterinarians would quickly think of canine leptospirosis. Brucellosis and Q fever might also come to mind. However, it would be a surprise to many veterinarians to learn that canine and feline urinary *Escherichia coli* strains have, in recent years, been implicated as potentially zoonotic.

Early on, interest focused upon the fact that *E. coli* strains obtained from humans (mostly women) and companion animals with urinary tract infections (UTI) shared many, identical virulence factor genes. Possession of these genes, and expression of their protein products, enable a small subset of all *E. coli* strains to colonize, persist and multiply within the host's urinary tract. It was argued that–since many canine and feline urinary *E. coli* strains have virulence factors relevant to gaining entry and persisting within *human* urinary tracts–dogs and cats should be viewed as potential reservoirs of uropathogenic *E. coli* for humans.

Interest has not been restricted to urine, either. It was shown that canine and feline faeces sometimes contain *E. coli* strains apparently equipped to be uropathogenic to humans. This came as no real surprise because it had been known for some time that the usual source of uropathogenic *E. coli* in individuals with UTI is that individual's own gastrointestinal flora. This seems to be as true for dogs and cats as it is for people. More surprising, though, was the fact that dogs with a primary problem of diarrhoea (and no UTI) were found often to harbour in their faeces haemolytic strains of *E. coli* with strongly 'uropathogenic' virulence factor profiles. The risk of exposure to pathogens in diarrhoeic faeces is considered much greater because diarrhoeic faeces are voluminous and more likely to contaminate the animal's coat and surrounding environment.

Demonstrating that *E. coli* strains derived from dogs and cats carried many of the same urovirulence genes as do strains derived from humans with UTI was not quite enough to prove that these human and animal strains were actually closely related and being transferred from one species to another. Perhaps only strains with "special pathogenicity" (*i.e.,* possession of a necessary set of virulence factors) could gain access to the urinary tract, persisting and multiplying there, in that relatively hostile environment. So strains of diverse genetic origins might, of necessity, evolve convergently to acquire the virulence genes prerequisite for them ever to be detected as uropathogens.

However, in 2001 it was shown directly that some urinary *E. coli* isolates from dogs were related to human strains that could cause serious, extraintestinal disease, including UTIs. Consequent to this discovery, it was suggested that the strong similarities between canine and human extraintestinal pathogenic *E. coli*, or even the "commonality" of strains derived from the two species, had potentially important implications for human disease prevention, antibiotic resistance avoidance, and studies of pathogenesis. In other words, the use of antibiotics in dogs was targeted for scrutiny since such antibiotic use could potentially lead to the emergence of antibiotic-resistant human pathogens.

In 2004, even more compelling and direct evidence was presented that humans can share uropathogenic *E. coli* with their companion animals. A young heterosexual couple and a pet cat belonging to the man were studied. The couple ate, slept, and had sex together three times a week but otherwise lived apart. The cat lived with the man and ate only cat food. It was shown that, over the course of a 12 week period, a particular clone of uropathogenic *E. coli* was transmitted from the man (he had a low-level infection in his urine throughout the study) to his partner. Subsequently, on weeks 4 and 9, this same clone was detected in the cat's faeces. On week 12, this clone caused an acute, symptomatic episode of cystitis in the woman, which was successfully treated with a 3-day course of a fluoroquinolone antibiotic. Although it seems likely that the cat was an 'innocent bystander' in this study, possibly infected by its male owner, nevertheless it provides fascinating evidence of direct host-to-host transmission of uropathogenic *E. coli* and lends further support to an argument that companion animals should perhaps be viewed as potential reservoirs of uropathogenic *E. coli* for humans.

Recent work done in New Zealand, which has not yet been subjected to peer review, has shown that canine, feline and human urinary *E. coli* isolates can be distinguished on the basis of virulence factor profiles with reasonable accuracy using discriminant analysis. This work suggests that, to a large extent, *"we have our strains and they have theirs"*. However, this finding certainly does not negate arguments that there is some host species overlap and therefore the potential for cross-species transmission of uropathogenic *E. coli*.

The risks to human health posed by contact with infected canine or feline urine have yet to be directly assessed. Many dogs and cats have prolonged 'asymptomatic' UTIs and could act as a source of infection to their human contacts during such prolonged periods.

Research conducted in America and published recently in the AVMA Journal is somewhat comforting, in that it suggests that dogs are unlikely to be an important reservoir of antibiotic-resistant *E. coli*

strains that cause urinary tract infections in women. Rather, the results suggest that dogs could potentially acquire infection with these resistant *E. coli* strains from their human contacts.

Much more work needs to be done, but it seems prudent at this stage to recommend that veterinary staff treat known and suspected *E. coli*-infected canine and feline urine with a measure of respect, as if it were potentially hazardous. Given the existence of many 'asymptomatic' canine and feline UTIs, this advice should perhaps be applied to all canine and feline urine.

Further Reading

Freitag, T; Squires, RA; *et al.* Feline uropathogenic *Escherichia coli* from Great Britain and New Zealand have dissimilar virulence factor genotypes. Veterinary Microbiology 2005; 106: 79-86.

Johnson, JR; Stell, AL; *et al.* Phylogenetic and pathotypic similarities between *Escherichia coli* isolates from urinary tract infections in dogs and extraintestinal infections in humans. Journal of Infectious Diseases 2001; 183: 897-906.

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Sannes, MR; Kuskowski, MA; Johnson, JR. Antimicrobial resistance of *Escherichia coli* strains isolated from urine of women with cystitis or pyelonephritis and feces of dogs and healthy humans. Journal of the American Veterinary Medical Association 2004; 225: 368-373.