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Multi-drug Resistant (MDR) Urinary Tract Infections in Canine

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Abstract: Canine urinary tract infections (UTIs) are common and are frequently treated empirically with first-line antibiotics. More and more multidrug-resistant (MDR) bacteria are being found in the urinary tracts of pets, especially those that have just undergone antibiotic treatment, are hospitalized, or have other underlying medical issues. A large number of MDR bacteria encountered are resistant to all commonly used oral antibiotics. This growing incidence makes therapy more difficult, increasing treatment failure, prolonged illness, and public health issues. Effective management requires improved diagnostics, judicious antibiotic use, exploration of alternative therapies, and public awareness. A proactive approach is desperately needed to prevent resistance, improve therapy, and safeguard the health of both humans and animals in light of the rise of multidrug-resistant bacteria in canine UTIs.

Keywords: canine, multidrug resistance, urinary tract infection, bacteria

Introduction

Antimicrobial resistance (AMR) is a worldwide health concern. According to the "One Health" concept, environments and animals have a significant impact on the development of antibiotic resistance. Development of AMR by urinary tract bacteria is of growing concern in both human and veterinary medicine. Over the last two decades, it has been clear that the urinary tract of healthy dogs and humans and is inhabited by variety of microorganisms that form the so-called urinary microbiome or urobiome. Urinary tract infections (UTIs) are one of the most common disorders occurring in companion animals. Throughout their lives, they affect about 14% of dogs, more commonly older and neutered female dogs who are 7 to 8 years old.

Several bacteria have been isolated, such as *Staphylococcus* spp., *Escherichia coli, Klebsiella* spp., *Proteus* spp., *Streptococcus* spp., and *Enterococcus* spp. The multidrug resistant (MDR) phenotype to antibiotics may be associated with these bacteria, which are commonly found in urine. Although there is a lack of information regarding the profile of antibiotic resistance, healthy dogs may exhibit bacteriuria and positive urine culture tests. In dogs with underlying diseases, up to 95% of UTIs are clinically silent, and there is no clear link between the presence of a UTI and the development of stranguria, pollakiuria, or pigmenturia. Correcting any treatable underlying problems and identifying if the same bacterial isolate is responsible for subsequent infections are crucial steps in managing recurrent or persistent UTIs (i.e., persistent infection or relapse versus reinfection) and whether there have been changes to the pattern of antimicrobial susceptibility.

Common MDR Urinary Bacteria

The term MDR bacteria refer to bacteria that are resistant to three or more groups of antimicrobials. Prior usage of antibiotics in the veterinary patient or its environment is the single most significant factor that predisposes to the existence of MDR bacteria. Urinary implants or older animals with coexisting diseases that weaken host defenses or make the host more vulnerable to bacterial entrance and persistence are the main sources of canine urinary MDR bacteria.

Beta-lactam resistant Enterobacteriaceae

The most commonly recommended and safest antimicrobial drugs for UTIs are β-lactam antibiotics. They belong to a class of broad-spectrum antibiotics whose molecular structure contain a beta-lactam ring. β-lactam resistance is commonly encountered in urinary *E. coli*, *Klebsiella* spp. and Proteus. *E. coli* is the most common pathogen isolated from the urinary system in canine, which makes around 33–55% of isolates from UTI cases.

Methicillin-resistant staphylococci

The mecA or mecC gene is found in a mobile genetic element that is present in methicillin-resistant staphylococci. The penicillin-binding protein PBP2a, which is encoded by these genes, permits the essential cross-linking in cell wall production to continue even in the presence of most β-lactam antimicrobials. Concurrent resistance to other antimicrobials, including fluoroquinolones, sulphonamides, and aminoglycosides, is very common in methicillin-resistant staphylococci. Overall, staphylococci were isolated from 4–14% of urine cultures obtained from dogs. In published research on methicillin resistance, coagulase-positive staphylococci are the main focus.

Enterococci

Enterococci, particularly *Enterococcus faecium* and *E. faecalis* comprised 3.7–24.4% of urinary bacteria in dogs. Due to intrinsic resistance mechanisms, enterococci should be considered resistant to trimethoprim/sulfonamide, cephalosporins, aminoglycosides and clindamycin. Acquired resistance may also be observed to antimicrobial groups such as β-lactams, fluoroquinolones, aminoglycosides, macrolides, lincosamides, glycopeptides, and tetracyclines, as well as biofilm formation.

Other bacteria

Other bacteria that are infrequently isolated from the urinary tract of canine, yet often express multidrug resistance, include *Pseudomonas* spp., *Acinetobacter spp*., *Enterobacter* spp.

Factors Contributing to MDR in Canine UTIs

Overuse of antibiotics: Excessive or inappropriate use of antibiotics in both human and veterinary medicine contributes to the development of resistance.

Suboptimal antibiotic therapy: Incomplete treatment courses or using antibiotics that are not effective against the specific bacteria involved can lead to resistance.

Contamination of the environment: Resistant bacteria can persist in the environment, including water, soil, and animal faces, contributing to their spread.

Genetic factors: Bacteria can acquire resistance genes through various mechanisms, including mutation and horizontal gene transfer.

Zoonotic transmission: Resistant bacteria can be transmitted between humans and animals, further complicating the issue.

Lack of proper hygiene: Poor hygiene practices can facilitate the spread of resistant bacteria.

Impact of MDR on Canine UTI Management

Treatment challenges: MDR bacteria limit the available treatment options, requiring the use of alternative or more potent antibiotics, which may have increased side effects.

Economic burden: Treatment of MDR UTIs often requires more expensive and specialized therapies, increasing the financial burden on pet owners.

Increased risk of treatment failure: The inability to effectively treat UTIs can lead to persistent infections, increased morbidity, and potential complications.

Management of MDR bacteria on Canine UTI

Responsible antibiotic use: Adhering to guidelines for antibiotic use, including culture and susceptibility testing before treatment, is crucial.

Proper Diagnosis: The diagnosis of subclinical bacteriuria and urinary tract infection should be based on culture of properly collected and stored urine. The importance of correct sampling of urine is further highlighted by the fact that MDR bacteria can colonise veterinary staff or owners; they may be transmitted from humans to dogs or vice versa and could potentially contaminate the urine of dogs if aseptic procedures are not followed.

Vaccination: While not specifically for UTIs, core vaccinations help maintain overall canine health and may indirectly reduce the risk of UTIs.

Improved sanitation: Good hygiene practices, including proper waste disposal and handwashing, can help prevent the spread of resistant bacteria.

Surveillance: Monitoring the prevalence of MDR bacteria in the veterinary community is essential for developing effective prevention and control strategies.

Conclusion

Overall, addressing MDR in canine UTIs requires a multi-faceted approach involving veterinarians, researchers, and public health officials to protect both animal and human sensitivity tests in veterinary medicine contributes to overall antimicrobial stewardship and helps protect public health.

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