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Antibiotic Susceptibility of Common Bacterial Pathogens in Canine Urinary Tract Infections

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Abstract:

Urinary tract infections are among the most common infections with an increasing resistance to antimicrobials in canines. The aim of this study was to determine the differences in antimicrobial susceptibility /resistance among various pathogens by using the FRAT formula. Thirty two (32) bacterial isolates from urine of dogs with significant bacteriuria in UTI were collected and evaluated for their antibiotic sensitivity using modified Kirby-Bauer method. The most common etiological organisms of UTI were E.coli (68.75 %), Staphylococcus aureus (12.5 %), Proteus mirabilis (9.37 %), Klebsiella pneumoniae (6.25 %) and Streptococcus spp. (3.13 %). Antimicrobial impact factor decreased for commonly used antibiotics such as amoxicillin, ampicillin, tetracycline, amikacin, gentamicin and trimethoprim. All the isolates exhibited high degree of resistance to commonly used ampicillin and amoxicillin. Hence the increasing rate of resistance of UTI pathogens to commonly used antibiotics, rational prescription and use of antibiotics is advocated.

Key words: *Urinary tract infections, FRAT, bacterial pathogens, susceptibility*

Inroduction

Urinary tract infection is thought to be the most common infectious disease in dogs. It has been estimated that 10% of all canine patients seen by veterinarians for any reason have UTI in addition to the problems for which they are presented (Cetin *et al.,* 2003). However, the aetiology of UTI and their antibiotic sensitivity patterns vary from time to time and across different areas. The emergence of antibiotic resistance is a serious issue, particularly in the developing world where there is a high prevalence of fake and spurious drugs of questionable quality in circulation. This study determines prevalence of frequently isolated urinary pathogens and their antibiotic susceptibility profile.

Materials and Methods

A total of 32 bacterial UTI isolates collected from the Mannuthy and Kokkalai University Veterinary Hospitals were used in the study. The isolates were confirmed to have UTI by urine culture of colony counts as per Dunning and Stonehewer (2002) and Bartges (2004).

The bacterial isolates were spread uniformly on nutrient agar plate and incubated at 37°C for 24h. The isolates were subcultured periodically. The isolates were re-identified and confirmed using standard microbiological method where

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includes gram staining, colonial morphology on media, and growth on selective media, lactose fermentation, catalase, oxidase, coagulase, indole, citrate utilization and urease tests (Gatoria, 2006). Antibiotic susceptibility testing was performed by the disc diffusion assay on Muller Hinton Agar using the following Antibiotics Disc, Cephalexin, Cefadroxil, Cefotaxime, Cefixime, Cefpodoxime Proxetil, Ceftriaxone, Amikacin, Gentamicin, Penicillin G, Ampicillin, Amoxicillin, Cloxacillin, Nalidixic Acid, Gatifloxacin, Norfloxacin, Ciprofloxacin, Pefloxacin, Ofloxacin, Sparfloxacin, Levofloxacin, Tetracycline, Doxycycline, Erythromycin, Vancomycin, Meropenam, Chloramphenicol, Nitrofurantoin, Co-Trimoxazole, Trimethoprim, Piperazine/ Tazobactom, Ampicillin/ Sulbatum, Amoxy/ Clav and Cefoperazoone/ Sulbactum. Interpretation of diameter of growth inhibition zone was done by using the standard interpretative chart.

Organisms were scored as sensitive or resistant. The impact factor for individual antimicrobial drugs were calculated using susceptibility data for isolates and the formula to help select rational antimicrobial therapy (FRAT, Equation 1). (Blondeau and Tillotson, 1999). F=% I × % S/100. Where the impact factor is F, I is % incidence of pathogens in samples, S is % susceptible to the antibiotics.

Results and Discussion

Out of the 32 isolates used for this study, the distribution of bacterial isolates was as follows *E.coli* (68.75 %), *Staphylococcus aureus* (12.5 %), *Proteus mirabilis* (9.37 %), *Klebsiella pneumoniae* (6.25 %) and *Streptococcus spp*. (3.13 %). The vast majority of canine UTIs are caused by a single bacterial species, and E.coli was most prevalent in canine UTIs. These findings were in close agreement with those of Keskar *et al.* (1998). Other studies have had similar results for *E.coli* and *Staphylococcus aureus* but for other isolates prevalence fluctuates. The difference in prevalence of bacterial uropathogens might be due to geographical factors (Ball *et al.,* 2008). The results of antibiotic susceptibility and calculated overall activity for organisms recovered from canine urine samples are summarized in Table 1.

These data were obtained from cystocentesis urine specimens. Of the 33 agents summarized, seven agents had overall activity in excess of 90%. Whereas five agents had overall activity between 80 to 90 % activity. Piperacillin /tazobactam, fluoroquinolones such as gatifloxacin, norfloxacin, ciprofloxacin, pefloxacin, ofloxacin, sparfloxacin and levofloxacin and 3rd generation cephalosporins like cefotaxime, cefixime, cefpodoxime proxetil and cefoperazone/ sulbactam had the highest cumulative antimicrobial impact factors, reflecting the high frequency of *in vitro* susceptibility to these drugs among the bacterial isolates. Antimicrobial impact factor decreased for commonly used antibiotics such as amoxicillin, ampicillin, tetracycline, amikacin, gentamicin and trimethoprim.

Table-1 Calculation of rational antimicrobial therapy

Antibiotics	*E.coli*		*S.aureus*		*P. mirabilis*		*K.pneumoniae*		*Streptococci spp.*		*%overall activity*
	%S	F	%S	F	%S	F	%S	F	%S	F	
Cephalexin	68.2	46.89	25	3.13	66.7	6.25	50	3.13	0	0.00	59.39
Cefadroxil	68.2	46.89	25	3.13	66.7	6.25	50	3.13	0	0.00	59.39
Cefotaxime	90.9	62.49	75	9.38	66.7	6.25	50	3.13	100	3.13	84.37
Cefixime	90.9	62.49	75	9.38	66.7	6.25	50	3.13	100	3.13	84.37
Cefpodoxime proxetil	100	68.75	75	9.38	66.7	6.25	50	3.13	100	3.13	90.63
Ceftriaxone	77.3	53.14	75	9.38	66.7	6.25	0	0.00	0	0.00	68.77
Amikacin	77.3	53.14	25	3.13	66.7	6.25	100	6.25	0	0.00	68.77
Gentamicin	77.3	53.14	25	3.13	66.7	6.25	100	6.25	0	0.00	68.77
Penicillin G	50	34.38	50	6.25	33.3	3.12	100	6.25	100	3.13	53.12
Ampicillin	40.9	28.12	50	6.25	33.3	3.12	100	6.25	100	3.13	46.87
Amoxicillin	40.9	28.12	50	6.25	33.3	3.12	100	6.25	100	3.13	46.87
Cloxacillin	45.5	31.28	75	9.38	33.3	3.12	100	6.25	100	3.13	53.15
Nalidixic acid	31.8	21.86	50	6.25	66.7	6.25	0	0.00	34.4	1.08	35.44
Gatifloxacin	95.5	65.66	75	9.38	100	9.38	100	6.25	100	3.13	93.78
Norfloxacin	90.9	62.49	50	6.25	100	9.38	0	0.00	100	3.13	81.24
Ciprofloxacin	81.8	56.24	50	6.25	100	9.38	100	6.25	100	3.13	81.24
Pefloxacin	95.5	65.66	75	9.38	100	9.38	100	6.25	100	3.13	93.78
Ofloxacin	95.5	65.66	75	9.38	100	9.38	100	6.25	100	3.13	93.78
Sparfloxacin	95.5	65.66	75	9.38	100	9.38	100	6.25	100	3.13	93.78
Levofloxacin	95.5	65.66	75	9.38	100	9.38	100	6.25	100	3.13	93.78
Tetracycline	63.6	43.73	75	9.38	100	9.38	0	0.00	0	0.00	62.48
Doxycycline	63.6	43.73	75	9.38	100	9.38	0	0.00	0	0.00	62.48
Erythromycin	59.1	40.63	50	6.25	100	9.38	50	3.13	0	0.00	59.38
Vancomycin	77.3	53.14	75	9.38	100	9.38	0	0.00	0	0.00	71.89
Meropenam	81.8	56.24	50	6.25	100	9.38	50	3.13	0	0.00	74.99
Chloramphenicol	77.3	53.14	25	3.13	100	9.38	50	3.13	100	3.13	71.89
Nitrofurantoin	68.2	46.89	25	3.13	66.7	6.25	50	3.13	0	0.00	59.39
Co-trimoxazole	63.6	43.73	50	6.25	66.7	6.25	0	0.00	100	3.13	59.35
Trimethoprim	63.6	43.73	100	12.50	66.7	6.25	0	0.00	0	0.00	62.48
Piper/Tazobactam	100	68.75	75	9.38	100	9.38	100	6.25	100	3.13	96.88
Ampicillin/ sulbactam	54.5	37.47	50	6.25	33.3	3.12	0	0.00	100	3.13	49.97
Amoxicillin/ Clavulanate	45.5	31.28	50	6.25	33.3	3.12	0	0.00	100	3.13	43.78
Cefoperazone/ sulbactam	90.9	62.49	75	9.38	100	9.38	0	0.00	100	3.13	84.37

The Increased prevalence of resistance to clavulanic acid potentiated β-lactams obtained in the present study was comparable to other workers (Thompson *et al.,* 2011). Cetin *et al.,* (2003) reported that the most bacterial strains from UTIs in dogs were sensitive to amoxicillin/clavulanic acid followed by gentamicin, ampicillin/sulbactam, nitrofurantoin, and tetracycline. These findings indicate that the antimicrobial sensitiveness of bacteria isolated from dogs with UTIs was variable, and therefore antimicrobial agents should be selected on the basis of bacterial culture and sensitivity tests.

Prudent use of antimicrobials was an important step in reducing the emergence of antimicrobial resistance. In case of canine UTIs, prudent use includes considering most pathogens and their susceptibility patterns when choosing empirical treatment. Antimicrobial impact factors calculating using FRAT reflected the probability that a pathogen randomly selected from the study population was susceptible to a particular antimicrobial on disc diffusion assay.

Summary

In this present study, antimicrobial impact factors calculated using FRAT. Based on this factor, canine UTIs were likely to be susceptible to a number of antimicrobials. Small difference in impact factor were of little clinical significance, so other factors including antimicrobial use strategies to reduce the emergence of resistance, cost and convenience of administration must be considered when choosing empirical therapy.

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