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ETIOLOGIC STUDY OF URINARY TRACT INFECTION IN DOGS

ESTUDO ETIOLÓGICO DA INFECÇÃO DO TRATO URINÁRIO EM CÃES

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SUMMARY

Urinary tract infections were documented in 51 dogs. Several factors such as etiologic agents, localization of the infection, predisposing factors, sex, age, and breed were considered. The diagnosis of urinary tract infection (UTI) was based on bacteriological investigation and it was considered positive when urine sample collected by catheterization contained more than 10^5 bacteria/ml. Mixed infection was found in 4 of the infected dogs, totallizing 55 isolates. Among them, ***Escherichia coli*** (35.3%) was the most frequently isolated, followed by ***Staphylococcus*** sp. (23.5%), ***Proteus mirabilis*** (15.7%), ***Streptococcus*** sp. (13.7%), ***Klebsiella*** sp. (9.8%), ***Pseudomonas aeruginosa*** (3.9%), ***Enterobacter cloacae*** (2.0%), ***Citrobacter freundii*** (2.0%) and ***Providencia rettgeri*** (2.0%). As to antimicrobial susceptibility, norfloxacin and gentamicin were successful for the treatment of gram-negative microorganisms, while the most effective drugs for gram-positive bacteria were cephalothin and nitrofurantoin. UTI was observed more frequently in Cocker Spaniel and German Shepherd; male dogs were more involved, and pyelonephritis was the predominant disease observed. Infection was seen in all ages, but the frequency was higher in middle aged dogs. Urolithiasis were observed as common predisposing or underlying factors to UTI being, either ***Staphylococcus*** sp. or ***Proteus mirabilis*** isolated in those cases which alkaline urine pH was observed.

UNITERMS: Dogs; Urinary tract infections; Cystitis; Pyelonephritis

INTRODUCTION

Among the most frequently observed diseases in small animal clinics, the urinary tract infection is a common condition diagnosed in dogs and one of the major reasons for the indication of antimicrobial therapy. According to LING[18] (1983), this infection may occur at any time in the dog's life and about 14% of the canine population are infected, most of them showing no signs of the disease such as fever, depression, pain, hematuria or pollakiuria. The incidence of the infection might be higher. In fact, around 5 to 17% of the dogs submitted to physical examination for other problems have shown urinary tract infection.

Urinary tract infection in dogs is usually the result of bacteria ascending the tract from external segments, where a resident population of bacteria is present even when in good health. There is a progressively increasing number of bacteria from the mild portion of the urethra to distal urethra. This normal aerobic flora consists predominantly of ***Staphylococcus aureus***, ***Streptococcus*** sp., ***Corynebacterium*** sp. and ***Mycoplasma*** sp.[27].

Many defense mechanisms exist to avoid the growing and colonization of the bacteria, though. Among them, mechanical clearance of the organisms by frequent and complete voiding of urinary bladder contents and the intrinsic antibacterial property of the bladder mucosa surface capable of killing bacteria that may be present in small amount of urine remaining in the bladder after voiding in dogs and cats[15,24]. Also, the high osmolality and a low pH of the urine that can inhibit growth of many species of bacteria play an important role.

Several factors may alter those host defense mechanisms, being the instrumentation of the urinary tract, mainly in female dogs, the major extrinsic risk factor responsible for Urinary Tract Infection (UTI). Other predisposing factors are incontinence, genital manipulation, malformation such as cyst, diverticulum and long-term corticosteroid therapy or recent antibiotic therapy[2,5,11,12]. LING; KANEKO[20] (1976) and LING[19] (1984) emphasized a routine sediment evaluation for detection of UTI, and BARLOUGH et al.[1] (1981)

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reported that urine specimens submitted to sediment analysis could indicate the likelihood of the infection and this management could recommend for a further bacterial culture.

A bacteriological investigation is necessary to establish the diagnosis of infection of the urinary tract. A bacteriological culture obtained by sample collected by catheterization can be considered significant when there are more than 10^5 bacteria/ml, suggestive between 10^4 - 10^5 bacteria/ml and negative when the number of the organisms is smaller than 10^4 bacteria/ml[3,6]. According to COMER; LING[8] (1981), while no bacterial growth occurs in all samples obtained by cystocentesis, it occurs in samples collected by catheterization and voluntary voiding, respectively, in 26% and 85% of the cases. Because of this difference, a careful interpretation of the results is recommended to confirm UTI.

Since most of the UTI cases may be asymptomatic and unrecognized for a long time, when they are diagnosed, the treatment becomes difficult and there is, in some cases, an irreversible impairment of the organs[10,13,22].

According to COMER; LING[8] (1981) ***Streptococcus*** sp and ***Staphylococcus*** sp are the most common isolates from symptomatic or asymptomatic cases of UTI in dogs.

This investigation studied the prevalence of some microorganisms in dogs with UTI and its antimicrobial susceptibility.

MATERIAL AND METHOD

Fifty one dogs of both sexes and various breeds with UTI were examined in the Hospital Veterinário da Faculdade de Medicina Veterinária da Universidade de São Paulo, Brasil, between 1990 and 1991.

In each case, the diagnosis of the UTI was suspected by clinical history, and signs such as pollakiuria, polyuria, polydipsia, hematuria, dysuria, urinary incontinence and fever, alone or associated were observed. In addition, radiographic findings as uroliths, thickening of the bladder, mucosal irregularity, or decreased glomerular filtration rate were observed.

In some cases, when the dogs were asymptomatic, the presence of bacteriuria, pyuria or casts in urine sediment were suggestive of UTI[7]. In case of dogs receiving long-term corticosteroid therapy, the routine urinalysis revealed the likelihood of UTI.

Urine samples were obtained by catheterization after usual procedures of cleansing and vigorous asepsis of the genital area[6,23].

For quantitative urine culture, the samples were previously diluted (1:10 and 1:100) and 0.1 ml of diluted urine was cultured on blood agar and Mac Conkey agar plates respectively. Culture plates were incubated at 37ºC and examined for bacteriological growth after 24 hours, according to the method described by LENNETTE et al.[16] (1985) and EWING[9] (1986). The antibiotic susceptibility was performed by a standardized single disk method[4].

RESULTS

Presence of UTI was considered when the urine contained greater than 10^5 viable organisms per milliliter; positive culture was observed in all samples and mixed infection was found in 4 of the infected dogs, totalizing 55 isolates. ***Escherichia coli*** (18 out of 51 dogs), ***Staphylococcus*** sp. (12 out of 51 dogs) ***Proteus mirabilis*** (8 out of 51 dogs), and ***Streptococcus*** sp (7 out of 51 dogs) were the most common microorganisms isolated. Other isolates and the frequencies are presented in Table 1 and 2, the microorganisms isolated from 4 dogs with dual infection (in the same tables).

TABLE 1

Frequency of isolation of microorganisms from 51 dogs with urinary tract infection. São Paulo, Brazil, 1990 to 1991.

BACTERIA		FREQUENCY TOTAL	%
Escherichia coli		18	35.3
Staphylococcus sp.		12	23.5
Coagulase positive	(10)		
Coagulase negative	(02)		
Streptococcus sp.		07	13.7
Non hemolitic (Non enterococci)	(02)		
Beta hemolitic (Non group A, B or D)	(04)		
Alpha hemolitic (Viridans streptococci)	(01)		
Proteus mirabilis		08	15.7
Klebsiella sp.		05	9.8
K. pneumoniae	(04)		
K. oxytoca	(01)		
Pseudomonas aeruginosa		02	3.9
Enterobacter cloacae		01	2.0
Citrobacter freundii		01	2.0
Providencia rettgeri		01	2.0

( ) number of samples.

Urinary tract infections were seen at any age, but the frequency was higher in middle aged dogs (Fig.1). Cocker Spaniels (10), German Shepherd (8), Mongrel dogs (5) and Dalmatian (4) were the most frequently involved breeds. Great Dane, Pekingeese and Beagle (3 times each), Daschund and Old English Sheepdog (2 times each) and Doberman Pinscher, Boxer, Basset Hound, Fox, Afgan Hound, Fila Brasileiro, Poodle, Teneriff, Schnauzer, Miniature Pinscher (1 time each) were the other breeds involved. Male dogs were more affected (64.7%) than the females (35.3%). Lower UTI was found 38 times, comprising 74.5% of the cases, and upper UTI was found 13 times (25.5%). Surprisingly, pyelonephritis is the most frequently observed disease in male dogs (Fig. 1 and Table 3). Table 4 lists the risk factors hypothesized to play a role in the development of UTI. Among female dogs, the only factor was the presence of associated urolithiasis. On the other hand, concerning to male dogs, besides urolithiasis, factors such as congenital abnormalities of urinary bladder, prostatic disease or long-term corticosteroid therapy were related to the development or maintenance of UTI (Table 4).

The antimicrobial activity of drugs routinely used was tested against the isolates. Susceptibility profiles revealed that norfloxacin and gentamicin were the most active drugs gram-

TABLE 2

Microorganisms isolated from dogs with UTI (dual infection). São Paulo, Brazil, 1990 to 1991.

Case N º	AGE Years	BREED	SEX	SITE OF PROCESS	BACTERIA
01	5	German Shepherd	M	Pyelonephritis	***Staphylococcus*** sp. coagulase positive ***Streptococcus*** sp.
02	8	Boxer	F	Pyelonephritis	***Escherichia coli*** ***Pseudomonas aeruginosa***
03	4	German Shepherd	F	Cystitis	***E. coli*** ***Proteus mirabilis***
04	8	Boxer	M	Cystitis + Prostatic Diseases	***Staphylococcus*** sp. coagulase positive ***Streptococcus*** sp.

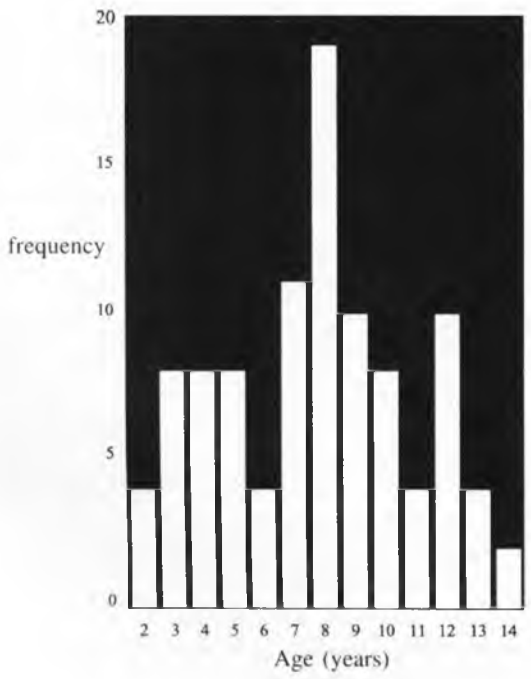

FIGURE 1
Distribution of UTI in dogs, according to the age.

TABLE 3

Occurrence of lower UTI and upper UTI in dogs. São Paulo, Brazil, 1990 to 1991.

SITE OF PROCESS	MALE	FEMALE	TOTAL
Lower UTI	21	17	38
Upper UTI	11	02	13
TOTAL	32	19	51

TABLE 4

Frequency of underlying factors identified in dogs with UTI. São Paulo, Brazil, 1990 to 1991.

PREDISPOSING FACTORS	MALE	FEMALE	TOTAL
Urolithiasis	06	05	11
Urachal Diverticulum	04	0	04
Prostatic hyperplasia	04	0	04
Corticosteroid therapy	03	0	03
TOTAL	17	05	22

TABLE 5

Antimicrobial activity against microorganisms isolated from dogs with urinary tract infections as percentage of susceptibility. São Paulo, Brazil, 1990 to 1991.

Antimicrobial Chemotherapy	*E. coli*	*Staphylococcus* sp	*P. mirabilis*	*Streptococcus* sp	*K. pneumoniae*
Norfloxacin	100 (18/18)	67 (8/12)	88 (7/8)	29 (2/7)	100 (4/4)
Gentamicin	94 (17/18)	58 (7/12)	100 (8/8)	14 (1/7)	100 (4/4)
Nitrofurantoin	89 (16/18)	83 (10/12)	25 (2/8)	57 (4/7)	25 (1/4)
Nalidixic acid	78 (14/18)	50 (2/4)	88 (7/8)	-	100 (4/4)
Tetracyclin	56 (10/18)	42 (5/12)	0 (0/8)	29 (2/7)	75 (3/4)
Sulfa+Trimethoprim	50 (9/18)	67 (8/12)	38 (3/8)	50 (2/4)	100 (4/4)
Ampicillin	44 (8/18)	29 (2/7)	63 (5/8)	50 (2/4)	0 (0/4)
Cephalothin	56 (10/18)	83 (10/12)	63 (5/8)	57 (4/7)	50 (2/4)
Penicillin	-	17 (2/12)	-	57 (4/7)	-
Oxacillin	-	50 (6/12)	-	40 (2/5)	-
Erythromycin	-	33 (4/12)	-	29 (2/7)	-

negative organism in this study, while gram-positive organisms were more sensitive to cephalothin and nitrofurantoin (Tab 5).

The frequency of isolation of microorganisms and the urinary pH from dogs with combined UTI and urolithiasis are listed on Tab 6.

TABLE 6

Urinary pH and microorganisms isolated from dogs with combined UTI and urolithiasis. São Paulo, Brazil, 1990 to 1991.

MICROORGANISM	FREQUENCY	pH
E. coli	5	6.0
Proteus sp	2	8.0 - 9.0
Staphylococcus sp	2	8.0
Streptococcus sp	1	6.0
Klebsiella sp	1	6.0

DISCUSSION

As observed elsewhere[12,14,17,28], ***Escherichia coli*** was the most frequent urogenital tract pathogen found in the dogs with UTI, followed by ***Staphylococcus*** sp, ***Proteus mirabilis*** and ***Streptococcus*** sp.

Bacterial contamination was distinguished from true bacteriuria by cultural determination of the number of bacteria in the urine. Samples containing more than 10^5 bacteria/ml of urine were indicative of the infection. As far as ***Klebsiella pneumoniae*** is concerned, 10^4 and 10^5 bacteria/ml was considered as a true infection, since this bacterium is not commonly found in the prepuce, urethra or vagina[27].

IHRKE et al.[12] (1985) observed that the prevalence of UTI in female dogs is substantially greater than in male dogs. However, in this study UTI was found more frequently in male dogs, in which predisposing factors could also be observed much more frequently.

Mixed UTI as reported by IHRKE et al.[12] (1985) was observed in four cases and could be explained by the long term disease and intermitent chemotherapy that had been used by the owners of the dogs.

Uroliths, anatomic alterations, bladder distension or urinary incontinence, instrumentation of urinary tract besides steroid therapy have been claimed to be involved as predisposing or underlying factors to UTI in dogs and at least four of them were identified in this study. Related to urolithiasis, those conditions were usually observed in association to the presence of urease-producing organisms, such as ***Staphylococcus aureus*** or ***Proteus mirabilis***, that lead to alkaline pH because of increased urinary ammonium concentration. As consequence, an extreme supersaturation of the urine develops and the likelihood of stone formation is markedly increased, mainly for struvite stones, which are the most frequently ones observed in canine urolithiasis[19,25].

Confirming that statement, more than one third of isolates from UTI associated to the presence of uroliths was due to urease-producing organisms and urinary pH was often alkaline, while the urine was acid in cases of urease negative microorganisms. The urinary pH may offer a simple evidence of the major species of bacteria involved in cases of urolithiasis, being a helpful screening test, at least in the first step of treatment.

The appropriate antimicrobial therapy was performed based

on antimicrobial susceptibility, during at least 14 days. Norfloxacin and gentamicin were successful for the treatment of gram-negative microorganism, while for ***Streptococcus*** sp. the most effective drugs were cephalothin, penicillin, and nitrofurantoin and for ***Staphylococcus*** sp., cephalothin and nitrofurantoin gave the best results. Gentamicin was used only as an agent of last resort where no other effective drug was available, considering that it has a high risk of toxic side-effects especially with prolonged therapy. This spectrum of susceptibility was reported by OXENFORD et al.[26] (1984). Regarding to trimethoprim-sulfa association, its good activity against ***Klebsiella*** sp, and its minor efficiency for ***Proteus*** sp and ***Escherichia coli*** had previously been described by LING; RUBY[21] (1979). The results observed in our present study showed the need for a careful evaluation of the microorganism involved and its susceptibility to antimicrobial substances, instead of the widespread use of those chemotherapeutic agents as commonly observed in small animal practice.

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RESUMO

Foram estudados 51 casos de infecção urinária, em cães, considerando-se diversos fatores, tais como: agente etiológico, localização da infecção, fatores predisponentes, sexo, idade e raça. O diagnóstico da infecção do trato urinário (ITU) foi baseado no exame bacteriológico, sendo considerado positivo quando a amostra de urina, colhida com auxílio de cateter, apresentava acima de 10^5 bactérias/ml. Dos animais examinados, quatro cães apresentaram infecção mista, totalizando 55 microorganismos isolados. ***Escherichia coli*** foi a mais freqüentemente isolada (35,3%), seguida de ***Staphylococcus*** sp (23,5%), ***Proteus mirabilis*** (15,7%), ***Streptococcus*** sp (13,7%), ***Klebsiella*** sp (9,8%), ***Pseudomonas aeruginosa*** (3,9%), ***Enterobacter cloacae*** (2,0%), ***Citrobacter freundii*** (2,0%) e ***Providencia rettgeri*** (2,0%). Quanto à sensibilidade dos germes isolados frente a diversos agentes antimicrobianos, a norfloxacina e a gentamicina mostraram-se eficazes no tratamento de microorganismos Gram-negativos, enquanto a cefalotina e a nitrofurantoina foram mais eficazes contra bactérias Gram-positivas. Os animais que apresentaram maior frequência de ITU pertenciam às raças Cocker Spaniel e Pastor Alemão, envolvendo mais machos do que fêmeas com predominância de pielonefrites. Embora as infecções urinárias tivessem sido observadas em todas as idades, houve um predomínio nos cães de média idade. Observou-se ainda que a urolitíase foi um fator pré-disponente ou adjacente de ITU, envolvendo germes como ***Staphylococcus*** sp. e ***Proteus mirabilis*** naqueles casos com pH urinário alcalino.

UNITERMOS: Cães; Infecções Urinárias; Cistite; Pielonefrite

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