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Short Communication

The Prevalence and Antimicrobial Susceptibility of Bacterial Uropathogens Isolated from Pediatric Patients

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Abstract

Background: Urinary tract infection (UTI) is considered as the most common bacterial infectious disease seen among the pediatric patients. The aim of this study was to investigate the prevalence and antimicrobial susceptibility of bacterial uropathogens isolated from the pediatric patients with urinary tract infections.

Methods: This descriptive study was conducted in Children Medial Center, Tehran, Iran from March 2006 to Feb 2007. Clean-catch midstream urine specimens were obtained from the patients and cultured on the appropriate bacteriological media. Bacterial isolates were identified by standard biochemical and serological tests. Antimicrobial susceptibility testing was performed according to CLSI guidelines.

Results: From 14199 urine specimens, 16.2% had positive results for bacterial cultures. Nine hundred twenty one strains were identified as *Escherichia coli*; 412 as *Klebsiella* spp., 285 as Coagulase negative *Staphylococcci*, 202 as *Enterococcus* spp., 158 as *Pseudomonas* spp., and 83 as *Staphylococcus aureus*. *E. coli* isolates showed high resistance to carbenicillin (68%), ampicillin (96%), trimethoprim-sulfomethoxazol (70%) and kanamycin (65%). More than 30% of isolates of *Klebsiella* spp., *Pseudomonas* spp. and *Enterobacter* spp. have shown high degree of resistance to commonly used antibiotics.

Conclusion: Our findings reinforce the need for ongoing investigation to show trends in antibiotic resistance, which can help to prescribing of antibiotics in clinics.

Keywords: *Urinary tract infections, Gram negative bacteria, Gram positive bacteria, Iran*

Introduction

Urinary Tract Infections (UTIs) are one of the most common bacterial diseases worldwide (1). They are one of the most common bacterial diseases in children and can be asymptomatic or symptomatic, characterized by a wide spectrum of symptoms ranging from mild irritative voiding to bacteremia, sepsis, or even death. In recent years, widespread use of antibiotics has been resulted in an increasing incidence of antibiotic resistance among the urinary tract pathogens all over the world. Worldwide, emerging of antibiotic resistance is increasing among the urinary pathogens (2, 3). More than 80% of bacterial strains causing urinary tract infections in developing countries are now resistant to trimethoprim or trimethoprim-sulphamethoxazole. In developing countries, these antibiotics are commonly prescribed as first-line drug for treatment of urinary tract infections particularly uncomplicated cystitis (4).

The current study was undertaken to determine the prevalence and antimicrobial susceptibility of uropathogens causing urinary tract infections among the pediatric patients admitted to Children's Medical Center, Tehran, Iran.

Material and Methods

Study design, specimen collection and bacterial identification

The study was conducted from March 2006 to Feb 2007. The study included all pediatric patients with urinary tract infection admitted to Children Medial Center, in Tehran, Iran in 2003. First physical ex-

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amination and complete history were taken for each patient. Mid-stream urine samples (MSU) were collected in sterile disposable containers. Urine specimens were subjected for general urine examination using direct microscopy for white blood cell (WBC) counts. Urine samples were cultured on Mac Conkey, blood agar and CLED (cystine-lactose-electrolyte-deficient) agar then incubated for 24 h at 37 °C (5, 6). The colony count cultures $\geq 10^5$ cfu/ml were considered significant and included in the study. The isolated bacterial strains were further identified microbiologically according to standard laboratory methods. Classification of positive urinary samples was carried out based on the guidelines of Infectious Disease Society of America (7).

Antimicrobial susceptibility testing

Antimicrobial susceptibility testing was performed according to the standard CLSI guideline (8) using 17 antibiotic disks: carbenicilli (PY, 100µg), ciprofloxacin (CP, 5µg), ceftriaxon (CRO, 5µg), tobramycin (TOB, 10µg), ceftazidime (CAZ, 30µg), ceftizoxime (CT, 30µg), gentamicin (GM, 10µg), piperacilline-tazobactam (PTZ, 85 µg), ampicillin (AM, 10µg), trimethoprim-sulfamethoxazole (SXT, 30µg), cephalothin (CF, 30µg), Nitrofurantoin (FM, 50µg), nalidixic acid (NA, 30µg) and chloramphenicol (C, 30µg) for gram negative isolates and penicillin (P, 10µg), ciprofloxacin (CP, 5µg), ceftriaxon (CRO, 5 µg), vancomycin (V, 30µg), cefazolin (CZ, 30µg), cephalexin (CFX, 30µg), clindamycin (CD, 2µg), erythromycin (E, 15µg), amikacin (AK, 30µg), gentamicin (GM, 10µg), cloxacillin (CX, 5µg), ceftazidime (CAZ, 30µg), ampicillin (AM, 10µg), trimethoprim-sulfamethoxazole (SXT, 30µg), cephalothin (CF, 30µg), nalidixic acid (NA, 30µg), Nitrofurantoin (NI, 50µg), and chloramphenicol (C, 30µg). *Staphylococcus aureus* ATCC 25923 and *E. coli* ATCC 25922 were used as quality control strains.

Results

A total of 14199 urine specimens were collected from pediatric patients. Of these, 2302 (16.2%) had positive results for bacterial cultures. In total, 40% of the strains belonged to *E. coli.* The isolation percentage of other bacterial species was: *Klebsiella* spp. (17.9%); Coagolase negative *Staphylococcocci* (12.3%); *Enterococcus* spp. (8.7%); *Pseudomonas* spp. (6.7%); *Staphylococcus aureus* (3.6%) and remainder (10.8%) was belonged to other bacterial strains (Table 1). *E. coli* isolates showed high resistance to carbenicillin, ampicillin, trimethoprim-sulfomethoxazol and kanamycin. Also high degree of resistance were observed in *Klebsiella* spp., *Pseudomonas* spp. and *Enterobacter* spp. that were resistance more than 30% to most of the commonly used antibiotics. All *Acintobacter* spp. strains were resistant to ceftazidime, cefixime and ceftizoxime. Similar trend was also seen among *Pseudomonas* spp. and *Enterobacter* spp. isolates for resistance to ampicillin. More than 50% of Coagolase negative *Staphylococcus, S. aureus* and *Enterococcus* spp. strains were resistant to the most of commonly used antibiotics.

Table 1: Prevalence and antimicrobial resistance of gram negative uropathogens isolated in the study

Uropathogens	N	*CB	CP	CRO	TOB	CAZ	CFM	CT	AK	GM	PTZ	AM	SXT	CF	NI	NA	K	C
E. coli	921	68	40	53	44	56	55	48	31	42	4	96	70	70	31	52	65	38
Klebsiella spp.	412	31	28	59	57	60	66	56	53	55	10	98	50	71	73	40	76	35
Pseudomonas spp.	158	51	8	87	56	66	99	97	31	43	53	100	90	100	97	96	95	96
Enterobacter spp.	83	34	39	55	53	65	60	64	59	49	60	100	57	89	72	57	79	27
Acinetobacter spp.	7	100	71	86	43	100	100	100	43	29	73	100	72	100	86	86	31	86
Citrobacter spp.	10	30	30	40	20	40	40	40	40	40	40	90	67	40	50	50	50	44
Proteus spp.	80	15	27	27	31	27	27	24	25	31	6	74	72	71	84	65	62	65
Providencia spp.	5	-	80	20	20	20	20	20	0	0	20	100	0	80	80	20	20	20
Hafnia spp.	2	50	100	50	0	50	50	50	0	0	0	100	100	0	50	100	100	50
Serratia spp.	4	25	100	50	25	50	50	50	20	25	25	75	75	25	75	75	75	75

*carbenicilli (PY,100 µg), ciprofloxacin (CP, 5µg), ceftriaxon (CRO, 5 µg), tobramycin (TOB, 10 µg), ceftazidime (CAZ, 30µg), ceftizoxime (CT, 30µg), amikacin (AK, 30µg), gentamicin (GM, 10µg), piperacilline-tazobactam (PT, 85 µg),, ampicillin (AM, 10µg), trimethoprim-sulfamethoxazole (SXT, 30µg), cephalothin(CF, 30µg), Nitrofurantoin(NI, 50µg), nalidixic acid (NA, 30µg) and chloramphenicol (C, 30µg).

Table 2: Prevalence and antimicrobial resistance of gram positive uropathogens isolated in the study

Uropathogens	N	*P	CIP	CRO	V	CZ	CFX	CD	E	AK	GM	CX	AM	SXT	CF	NA	NI	C
Coagolas Negative *Staphylococcus*	285	97	41	83	92	41	57	40	73	38	53	97	85	71	53	93	24	18
S. aureus	83	95	67	84	20	65	63	24	63	40	57	95	94	61	55	99	12	45
Enterococcus spp.	202	93	67	85	38	95	93	86	92	94	96	100	88	90	95	98	20	57
*Streptococcus (*viridans group*)*	45	82	67	41	13	53	53	38	71	75	86	91	88	91	53	96	13	30
Group D *Streptococcus*	1	100	100	100	0	100	100	100	100	100	100	100	100	100	100	100	100	100
Micrococcus	1	0	0	0	100	0	100	0	0	100	0	0	0	0	0	100	100	0
Diphteroids	2	50	100	100	0	50	50	0	0	50	50	50	100	50	50	100	100	50
Staphylococcus saprophyticus	1	100	-	-	100	100	100	100	100	100	100	100	0	0	100	100	0	-

*penicillin (PG, 10µg), ciprofloxacin (CP, 5µg), ceftriaxon (CRO, 5 µg), vancomycin (VA, 30 µg), cefazolin (CZ, 30 µg), cephalexin (CFX, 30 µg), clindamycin (CD,2µg), erythromycin (E, 5µg), amikacin (AK, 30 µg), gentamicin (GM, 10µg), cloxacillin (CX, 5µg), ceftazidime (CAZ, 30µg), ampicillin (AM, 10µg), trimethoprim-sulfamethoxazole (SXT, 30µg), cephalothin(CF, 30µg), nalidixic acid (NA, 30µg), Nitrofurantoin(NI, 50µg), chloramphenicol (C, 30µg) and chloramphenicol (C, 30µg)

Discussion

Infectious diseases are an important cause of mortality and morbidity in children (9). UTI as the most common bacterial infection refers to the presence of microbial pathogens within the urinary tract. It is generally associated with minimal morbidity except among specific subpopulations (10). Several bacterial species can cause UTI and bacteriuria by infecting the urinary tract system (11). It is a common bacterial illness in children (12, 13). In developing countries, where people do not have enough clean drinking water supply or adequate sewage disposal, UTIs are very common infections (14).

The members of the *Enterobacteriaceae* particularly *E. coli* and *Klebsiella* spp. are frequently reported as the most cause of UTI world wide (15, 16). A recent study carried out among women with uncomplicated UTIs in16 European countries and Canada showed the high prevalence of *E. coli* strains isolated in most groups and ages (2). In another study carried out in Sweden, *E. coli* has been reported as the most common pathogen in boys (79%) and girls (89%) with UTI (13). As shown in Table 1 and 2, *E. coli* strains were the most common bacteria (40%) isolated from urinary tract infections followed by *Klebsiella* spp. (17.9%). In addition, coagolase negative *Staphylococcus* spp. were the most common cause of UTI among gram positive bacteria emphasizing to this fact that these pathogens are still the most important causes of UTI worldwide.

In the last decades, antimicrobial resistance phenomenon has been growing rapidly among uropathogens worldwide (15, 17). On contrary, the number of reports about occurrence of bacteria with antibiotic resistance has been increasing all over the world. It has been shown that the incidence of resistance of *E. coli* isolated from urinary cultures increased for most of commonly used antibiotics (16). As reported in different studies, the most of UTIs are often due to multi-drug resistant uropathogens. As a result, accurate knowledge on local epidemiology and antimicrobial resistance patterns of uropathogens among the children is essential for designing a clinically effective therapy for UTI (18, 19).

The Children Medial Center is a major hospital for pediatric treatment in Tehran. We have recently investigated the prevalence of some infections and their antimicrobial resistance in this hospital (20-22), however in current study we observed a high level and generalized resistance to commonly used antibiotics particularly among gram-negative iso-

lates such as *E. coli* and *Klebsiella* spp. with high level of resistance to ampicillin, ceftazidime, and cephalotin and other commonly used antibiotics.

This resistance rate is higher than other countries. For example, resistance rate for trimethoprim- solfamethoxasol has been reported close to 25% among *E. coli* strains isolated in some European countries (13) while this resistance rate reached to 70% among the *E. coli* strains isolated in our study.

We concluded that the most of the urinary isolates had a high level of resistance to commonly used antibiotics.

There are many possible reasons for this alarming phenomenon, including inappropriate and incorrect administration of antimicrobial agents in empiric therapies and lack of appropriate infection control strategies (23-25). This problem indicates importance of performing antibiotic susceptibility testing before blind antibiotic therapy. Our findings reinforce the need for ongoing investigation to show trends in antibiotic resistance, which can help to prescribing of antibiotics in clinics.

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