Original Research Article

Culture sensitivity and antibiotic profile in urinary tract infection in children between 1-15 years

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ABSTRACT

Background: The aim was to study the antibiotic resistance in children with urinary tract infection and to observe any difference between antibiotic resistance rates.

Methods: It was a prospective study carried out in SKIMS Medical College Hospital, Srinagar over a period of two years from January 2017 to January 2019. The study included 210 children between 1 year and 15 years who had presented with complaints of urinary tract infection and whose urine cultures were positive for the growth of an organism. These children were analyzed in order to find the frequency of organisms grown on culture, sensitivity of organisms isolated on culture and the rates of developed resistance to the antibiotics.

Results: A total of 210 patients aged were included in the study, encompassing 66 (31.4) males and 144 (68.6%) females. Out of 144 female children 108 were under 6years of age while as out of 66 male children 48 were under 6years of age. As per the growth on urine culture, the commonest organism that grew on culture were *Escherichia coli* (*E. coli*) was observed in 156 (74.3%), enterococcus in 18 (8.57%), *Proteus mirabilis* in 11 (5.2%), *Acinetobacter* spp. in 7 (3.3%), Pseudomonas spp. 5 (2.4%), *Staphylococcus aureus* in 4 (1.9%), *Morganella spp.* in 3 (1.4%) patients. Authors found imipenem, aminoglycosides and nitrofurantoin as the most effective antibiotics for urinary tract infections in pediatric age group.

Conclusions: From this study, they concluded that parenteral antibiotics to be started empirically for the treatment of UTIs in all pediatric age groups are aminoglycosides. In contrast for outpatient management of urinary tract infections, our results suggest that nitrofurantoin should be used for children aged beyond 1 year of age due to the low rate of resistance to nitrofurantoin in patients aged over 1 year.

Keywords: Urinary tract infection, Children

INTRODUCTION

Urinary tract infections (UTIs) are one of the commonly seen infections in the pediatric age.[1] In pediatric age group patients, the morbidities associated with bacterial urinary tract infections ranks second only to upper respiratory tract infections.[2] The incidence of UTI is more common among boys until the age of 12 months. The pooled prevalence rate of febrile UTI in females is about 3-fold of circumcised males and UTI occurrence increases among uncircumcised male infants.[3,4] The reflux nephropathy is the most important complication of urinary tract infection in pediatric age group.[5] Among the micro-organisms responsible for UTI in pediatric age group, gram-negative bacilli are the common organisms grown in urine culture.[6,7] *E. coli* is encountered in 70–

80% of episodes of urinary tract infections.[6-8] Gram-positive microorganisms may be seen to grow in urine cultures of those patients who have either structural anomaly of urinary tract or in ICU settings.[9]

Due to frequent use of antibiotics, antibiotic resistance has developed among these organisms which prompts us to change the treatment protocol for urinary tract infection.[10-12]

METHOD

This study was a prospective observational study carried out in SKIMS Medical College Hospital, Srinagar over a period of two years from Jan 2017 to Jan 2019.

Children 1 year to 15 years of age presenting with symptoms of UTI or only fever with suspected UTI, plus a positive urine culture of a single organism according to standard guidelines were included in the study.

Patients who had received antibiotics before urine culture or samples that grew more than 1 type of micro-organism or fungal infection were excluded from the study.

A UTI was defined as ≥ 105 colony-forming units (CFU)/mL of midstream urine, ≥ 104 CFU/mL of urine obtained by transurethral catheterization, and ≥ 103 CFU/mL of gram-positive microorganism or any colony number of gram-negative micro-organism by suprapubic collection.

The age, gender, growth of organism grown on culture, their sensitivity and resistance patterns were noted. Urine samples were collected following standard perineal hygiene either by catheterization or by suprapubic method in patients below 2 years and from above 2 years patients midstream urine samples were obtained. Urine samples were sent to the laboratory where they were inoculated on MacConkey agar incubated at 37°C for 24 hours.

The Kirby-Bauer disc diffusion method was used to identify the in vitro antimicrobial susceptibility against Trimethoprim-sulfometaxazole (TMP-SMX), Ceftriaxone, Cefexime, Nitrofurantoin, piperacillin-Tazobactam, Tobramycin, Gentamycin, Ciprofloxacin, Amikacin, Amoxycillin-Clavulanate, and Ampicillin-Sulbactam.[14] Data analysis was performed using the IBM SPSS version.[22] Continuous variables were expressed as mean, frequency.

RESULTS

A total of 66 (31.4%) male, and 144 (68.6%) female children patients with a mean age of 4years were included in the study. It was a prospective study carried out in SKIMS Medical College Hospital, Srinagar over a period of two years from Jan 2017 to Jan 2019.

All patients who had come with suspected UTI with urine culture growing an organism were included in the study. UTI was twice as common in female children (68.6%) as compared to male children (31.5%). There were 48 (72.7%) males in the age group of 1-6 years as compared to 18 (27.27%) in the age group of 7-15 years out of total 66 male patients as shown in Table 1. Out of total 144 female patients 108 (75%) patients were in the age group 1-6 years and 36 (25%) patients were in the age group of 7-15 years as shown in Table 1.

Table 1: Age and Gender Distribution.

	1-6 years	7-15 years
Males (66n)	48 (72.7%)	18 (27.7%)
Female (144n)	108 (75%)	36 (25%)

The organisms that were isolated from the urine culture of patients in decreasing order were *Escherichia coli* (n=156; 74.3%), *Enterococcus spp* (n=18; 8.57%), *Proteus mirabilis* (n=11; 5.2%), *Acinetobacter spp.* (n=7; 3.3%), *klebsiella spp* n=6;2.8%), *Pseudomonas aeruginosa* (n=5; 2.4%), coagulase-negative *Staphylococcus aureus* (CONS) (n=4; 1.9%), and *Morganella* (3; 1.42%) as shown in Table 2. All of of MDR-E.coli app were isolated from female patients.

For E. coli, the resistance rates that were observed were ceftriaxone (26.9%), nitrofurantoin (13.4%) co-trimoxazole (39.1%), ampicillin-salbactam (68.6%) and amoxicillin-clavulanate (71.8%). Enterococcus spp. was seen more commonly in females (83.3%) compared to only 16.6% of male children as only three of those patients from whom Enterococcus was isolated were males out of eighteen patients. The overall susceptibility tests showed E. coli with a very high resistance to amoxicillin-clavulunate (71.8%) followed by ampicillin-salbactam (68.6%) and cotrimoxazole (39.1%). The antimicrobial resistance pattern of various isolated uropathogens is shown below in Table 3.

SNC-Sensitivity not checked. We found imipenem, aminoglycosides and nitrofurantoin as the most effective antibiotics for urinary tract infections in pediatric age group. Imipenem was seen with least resistance with only 2.3% of E.coli showing resistance to it.

Table 2: Organisms isolated on urine culture.

Organism	%
E. coli	74.30%
Enterococcus	8.75%
P.mirabilis	5.20%
Acinetobacter	3.30%
Klebsiella	2.8%
Pseudomonas	2.40%
Staphyloccus aureus	1.90%
Morganella	1.42%

Table 3: Antimicrobial resistance pattern in isolated uropathogens.

	E. coli (156)	Klebsilla (6)	Enterococcus (18)	Staph aureus (4)	Pseudomonas (5)	Proteus (11)	Acinetobacter (7)
Impenem	3.2% (5)	0	SNC	25%	0	18.2% (2)	28.5% (2)
Amikacin	5.1% (8)	16.6% (1)	33.3% (6)	50% (2)	20% (1)	27.7% (3)	42.80%
Gentamicin	5.1% (8)	16.6% (1)	33.3% (6)	50% (2)	20% (1)	27.7% (3)	42.80%
Ciprofloxacin	17.3% (27)	16.6% (1)	SNC	SNC	40% (2)	36.4% (4)	42.8% (3)
Tobramycin	5.1% (8)	16.6% (1)	SNC	SNC	60% (3)	36.4% (4)	42.8% (3)
Ceftriaxone	26.9% (42)	50% (3)	SNC	75% (3)	SNC	45.4% (5)	57.1% (4)
Cefexime	31.4% (49)	50% (3)	SNC	100%	SNC	63.3% (7)	100% (7)
Nitrofurantoin	13.4% (21)	83.3% (5)	27.7% (5)	50% (2)	SNC	90.9% (10)	SNC
Ampicillin /salbactam	68.6% (107)	83.3% (5)	61.1% (11)	75% (3)	SNC	63.6% (7)	SNC
Piperacillin/ Tazobactam	SNC	33.3% (2)	SNC	SNC	20% (1)	81.8% (9)	71.4% (5)
Cotrimoxazole	39.10% (61)	83.3% (5)	88.8% (2)	75% (3)	SNC	81.8% (9)	85.7% (1)
Linezolid	SNC	SNC	16.6% (1)	0	SNC	SNC	SNC
Amoxiclav	71.8% (112)	100%	88.2% (2)	SNC	SNC	72.7% (8)	SNC
Vancomycin	SNC	SNC	0	0	SNC	SNC	SNC

SNC sensitivity not checked

DISCUSSION

Urinary tract infections are one of the commonly seen bacterial infections in pediatric age. They are more common in female children than male which could be due to short urethra in females and close proximity of female urethra to anus leading to more chances of contamination in perineal area.[15] In our study 68.6% of the cases consisted of female children and 31.4% male children. The various studies performed in most parts of the world have demonstrated *E. coli* as the main uropathogen in UTI in children.[15-21] In our study, gram-negative bacteria were the most frequently isolated microbial agents in urine culture with *E. coli* only isolated in 74.3% of cases. This was followed by *Enterococcus* spp. (8.6%), *Proteus spp* (5.4%), Acinetobacter spp. (3.3%), *Klebsiella spp* (2.8%), *Pseudomonas aeruginosa*(2.4%), Coagulase negative *Staphylococcus aureus* (1.9%) and Morganella app (1.42%). Owing to very frequent use of some oral antibiotics in our region, this has led to development of high resistance to these antibiotics.[22] Ampicillin has demonstrated very high resistance in various parts of world with European countries (50%), African (100%), and 82% in Asian countries.[16,20,22] In our study the highest resistance of E.coli was found against amoxicillin/clavulunate (71.8%), followed by ampicillin-salbactam (68.6%) and cotrimoxazole (39.1%). In our study resistance rates of *E. coli* against increasingly prevalent ceftriaxone and cefexime were found to be 26.9%, and 31.4% respectively. These higher rates of resistance suggest that 3rd generation cephalosporins should not be preferred for the empirical treatment of

UTI. The high degree of resistance to β-lactam antibiotics observed in our study corresponds to earlier reports .[23] A similar study of antimicrobial resistance trends in E. coliuropathogen isolated from pediatric patients in Kerala also found high combined resistance to most commonly used antimicrobials including β-lactams.[23] Since, *E. coli* which is the most frequently isolated uropathogen in UTI has the lowest resistance rates against imipenem-cilastatin without any change in its resistance rates within years, this antibiotic combination is still a reliable alternative. As is the case in the whole world, enhanced resistance rates of *E. coli* against co-trimoxazole (39.1%) were detected in our study.[8, 16,20,21] Resistance rates of E.coli to other antibiotics were noticed in increasing order as aminoglycosides(5.1%), nitrofurantoin (13.4%) and quinolone(17.3%). *Enterococcus* spp. were universally sensitive to linezolidand nitrofurantoin in our study as none of them showed any resistance to these two antibiotics. The resistance of *Enterococcus* spp was highest for amoxicillin-clavulanicacid (88.8%), cotrimoxazole (88.8%) followed by ampicillin-salbactum (61.1%) and amikacin (33.3%). The most effective antibiotics against P. mirabilis were imipenem, amikacin and ciprofloxacin.

These higher resistance rates suggest that these antibiotics should not be selected for empirical treatment in our province. The reason for this higher resistance rates might be attributed to long-term preference of these antibiotics in general medical practice, and alteration in resistance rates with time. Thus, suggesting that these antibiotics should not be used for the empirical treatment of UTI in our part of world.

CONCLUSION

Urinary tract infections are one of common infections in pediatric age group with gram negative bacilli predominating the infections. Among the gram-negative bacilli, *E. coliare* the commonest causes of UTI in pediatric patients with an overall percentage of 70-80% as was seen in our study (74.3%). But there has been a gradual but an alarming increase in rate of resistance to antibiotics in previous years as is obvious from our study also. The increase in rate of resistance in our region is due to preference of these antibiotics by medical practitioners and over-the-counter use of some of these antibiotics. Hence there is need to decrease over-the-counter use of these drugs and medical practitioners of particular region must be aware of the changing trends of antimicrobial resistance of that region.

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