Bacteriology of urinary tract infection in paediatric patients at KIST Medical College Teaching Hospital

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Abstract

Background: Urinary tract infection is common in children and is an important cause of morbidity. Urinary tract infection at young age can lead to renal injury and scarring, and ultimately lead to end stage renal disease in adulthood.
Objectives: The purpose of study was to identify the different species of microorganisms, along with their antimicrobial susceptibility pattern, causing urinary tract infection in paediatric patients presenting with urinary tract infection at KIST Medical College, Imadol, Lalitpur, Nepal.
Methods: This retrospective study examined microbiological and antimicrobial susceptibility pattern for urine samples collected at KIST Medical College, Imadol, Lalitpur from December 2010 to November 2013. A urine sample was included in our dataset if it demonstrated pure growth of a single organism and accompanying antimicrobial susceptibility and subject demographic data were available.
Results: *Escherichia coli* was the most common organism isolated, followed by *Klebsiella* species, *Staphylococcus* species and then by *Proteus species*, *Enterococcus* species and *Citrobacter* species being equal in number. Microorganisms were most susceptible to amikacin and nitrofurantoin and most resistant to ampicillin and nalidixic acid.
Conclusion: Though various microorganisms are responsible for urinary tract infection in children, *Escherichia coli* is the most common causative agent. Antimicrobial resistance has already emerged against many antibiotics, making empiric treatment of these infections challenging.

Key words: Antimicrobial susceptibility pattern, Bacterial isolates, Urinary Tract infection, Urine culture

INTRODUCTION

Urinary tract infection (UTI) is considered to be one of common bacterial infections and is a major problem that is frequently encountered by paediatric healthcare providers[1]. UTI is also an important cause of bacteraemia due to gram negative organisms but with early diagnosis and management of UTI the incidence of morbidity and life threatening bacteraemia can be reduced. Approximately three to five percent of the girls and one percent of the boys acquire a UTI[2].

Escherichia coli, a gram negative bacteria belonging to family Enterobacteriaceae is the main causative agent of UTI but other Enterobacteriaceae like *Klebsiella pneumoniae, Proteus mirabilis* and others as well as *Staphylococcus saprophyticus* are also commonly involved[3,4]. With the introduction of antimicrobial therapy, management of urinary tract infections has been improved; however antimicrobial resistance is a growing problem and a cause of major concern in many countries[5-7]. Over the past several decades, resistance to most of the commonly prescribed UTI antibiotics- ampicillin, co-trimoxazole, nitrofurantoin, and fluoroquinolones has emerged[8].

This study was performed to find out the frequency of different types of microorganisms along with their antimicrobial susceptibility pattern causing urinary tract infection in paediatric patient at KIST Medical College, Imadol, Lalitpur in order to improve the management of the patients with the ultimate aim of guiding empiric therapy.

METHODS

This was a retrospective study done during December 2010 to November 2013. Ethical approval was taken

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from institutional review board prior to the study. Laboratory records from Clinical laboratory services of KIST Medical College, Teaching Hospital were reviewed. All the urine specimens submitted for urine culture and sensitivity from patients aged up to 15 years presenting in outpatient department and inpatient department who were suspected of UTI were included in the study. Contaminants growths were excluded.

In routine Clinical Laboratory Services processing, urine samples were cultured in five percent blood agar and Mac Conkey's agar. Inoculation was done with the help of a 0.001ml calibre loop. All the sample plates were incubated aerobically at 37°C for 24 hours. Culture negative and contaminants grown were reported for no growth of organisms in culture plates and multiple growths on culture plates respectively. Culture positive result was given if the number of bacterial colony grown on culture media exceeded 10^5 colony forming units (CFU) per ml of urine in case of clean-catch midstream urine but based on type of urine sample (straight catheterisation) submitted and clinical history (acute urethral syndrome, antibiotic therapy) of the patient, lower colony counts (10^3 CFU/ml) were also considered significant in some cases. Bacterial identification was done by colony morphology, Gram staining and standard biochemical tests [9]. Antimicrobial susceptibility test was performed by Kirby-Bauer disc diffusion technique. Different antimicrobial panels were used for different groups of microorganisms and second line antimicrobials were used only when necessary following the Clinical and Laboratory Standards Institute (CLSI) guidelines[10]. All the data were tabulated in Excel sheet and analysed using SPSS version 17.

RESULTS

Seven hundred and nineteen urine culture samples were included for analysis (384 samples were from male patients and 335 were from female patients). Out of 719 samples, 133 (18.49%) urine samples were culture positive. Information on patients' age and sex distribution as well as age and sex distribution of culture positive cases are shown in table 1 and table 2 respectively.

The most common organism causing the urinary tract infection in this study was *Escherichia coli* (n=86, 64.66%). Others were *Klebsiella pneumoniae* (n=17, 12.78%), *Staphylococcus aureus* (n=8, 6.01%), Coagulase negative *Staphylococcus* (n=5, 3.75%), *Proteus species* (n=4, 3%), *Enterococcus* (n=4, 3%), *Citrobacter* (n=4, 3%) and others (n=5, 3.75%). *E. coli* (43 from male and 43 from female) and *Klebsiella* (12 from male and 5 from female) were the most common microorganisms isolated from both male as well as female patients. Similarly *E. coli* and *Klebsiella* were the most common isolates in all age groups.

None of the antimicrobials had 100% efficacy except vancomycin. However it was used for Gram positive cocci only. For gram negative organisms, imipenem had the maximum efficacy (91.66% against all isolates and 88.88% against *E. coli*). Out of tested isolates most of the organisms were found to be sensitive to amikacin (79.66%), followed by nitrofurantoin (76.66%) and gentamicin (70.49%) whereas ampicillin and nalidixic acid had efficacy of 16.66% and 22.22% only. Among *E. coli*, the most common organism, 84.09% of isolates were sensitive to amikacin, 83.95% to nitrofurantoin and 74.07% to gentamicin. Commonly used drugs in UTI like ceftriaxone, ofloxacin and ciprofloxacin were found to be less effective accounting 34.28%, 40.90% and 55.55% respectively. The details of the antimicrobial susceptibility pattern of overall microorganisms and *E. coli* (most common microorganism) are shown in table 3 and 4 respectively.

Table 1: Age and sex distribution of study participants.

Age group	<1 year	1-5 years	5-15 years	Total
Male	36 (5%)	115 (16%)	233 (32.4%)	384 (53.4%)
Female	27 (3.7%)	109 (15.2%)	199 (27.7%)	335 (46.6%)
Total	**63 (8.7%)**	**224 (31.2%)**	**432 (60.1%)**	**719 (100%)**

Table 2: Age and sex distribution of culture positive cases

Age group	<1 year	1-5 years	5-15 years	Total
Male	13 (9.8%)	26 (19.5%)	31 (23.3%)	70 (52.6%)
Female	8 (6%)	18 (13.6%)	37 (27.8%)	63 (47.4%)
Total	**21 (15.8%)**	**44 (33.1%)**	**68 (51.1%)**	**133 (100%)**

Table 3: Antimicrobial susceptibility pattern of microorganisms (n=133)

Antimicrobials	Number of isolates tested	Number of sensitive isolates (%)	Number of intermediate isolates (%)	Number of resistant isolates (%)
Amikacin	59	47 (79.7)		12 (20.3)
Ampicillin	78	13 (16.7)		65 (83.3)
Ceftazidime	67	16 (23.9)		51 (76.1)
Ceftriaxone	35	12 (34.3)		23(65.7)
Ciprofloxacin	99	55 (55.6)		44 (44.4)
Co-trimoxazole	118	48 (40.8)		70 (59.3)
Gentamicin	122	86 (70.5)	2 (1.6)	34 (27.9)
Imipenem	24	22 (91.7)		2(8.3)
Nalidixic acid	90	20 (22.2)	1 (1.1)	69 (76.7)
Nitrofurantoin	120	92 (76.7)	2 (1.7)	26 (21.7)
Norfloxacin	114	49 (43)		65 (57)
Ofloxacin	44	18 (40.9)	3 (6.8)	23 (52.3)

Table 4: Antimicrobials susceptibility pattern of *E. coli*(n=86)

Antimicrobials	Number of isolates tested	Number of sensitive isolates (%)	Number of intermediate isolates (%)	Number of resistant isolates (%)
Amikacin	44	37 (84.1)	1(2.3)	6 (13.6)
Ampicillin	57	9 (15.8)		48 (84.2)
Ceftazidime	49	14 (28.6)		35 (71.4)
Ceftriaxone	26	10 (38.5)		16 (61.5)
Ciprofloxacin	67	30 (44.8)		37 (55.2)
Co-trimoxazole	78	28 (35.9)		50 (64.1)
Gentamicin	81	60 (74.1)		21 (25.9)
Imipenem	18	16 (88.9)		2 (11.1)
Nalidixic acid	60	6 (10)	1 (1.7)	53 (88.3)
Nitrofurantoin	81	68 (84)	1 (1.2)	13 (16)
Norfloxacin	78	29 (37.8)		49 (62.8)
Ofloxacin	33	10 (30.3)	2 (6.1)	21 (63.6)

DISCUSSION

The urinary culture positive rate was 18.49% in this study which was similar to rates of 19.3%[11] and 22.2%[12] in previous studies. However another study from Nepal showed 28% of culture positivity rate[13]. Though 81.51% of suspected cases were culture negative, this study did not focus for the causes (e.g. dysfunctional voiding, glomerulonephritis, Kawasaki diseases, viral cystitis, vulvovaginitis, or foreign body etc) as it was beyond the scope of objectives of this study. Overall, UTI was more common in male children (Male 52.63%, Female 47.36%) in all group except in 5-15 year where females were more predominant (Table 2). Similar pattern of sex distribution in urinary tract infection was also seen in previous study[14]. But study done by Sharma et al and Malla et al showed female preponderance in all age group[15,16]. Culture positive rates were similar in both male and female patients; however there were high number of male patients, suspected of urinary tract infection in age group of five to fifteen year. This was a hospital based study and probable gender bias in seeking medical treatment could be possible reasons for male being common in UTI.

E. coli was the most common organism isolated (64.66%) in our study which is consistent with findings of previous literature of 62.88%[14] and 67.5%[15] and some studies also reported higher incidence of *E. coli* 87 % and 92% respectively in their study[17,18]. *Klebsiella* isolated (12.78%) in present study is lower than other studies where incidence varied from 15.7 to 22%[12,15,19,20].

The urinary infections caused by *Staphylococcus* ranged from 0.7% to 8.5% in different studies[21-23] whereas in this

study *Staphylococcus aureus* and Coagulase negative *Staphylococcus* accounted for 6.01% and 3.75% of total infection respectively. *Proteus* was isolated only in three percent in this study whereas *Proteus* isolated ranged from 5.8% to 12.4% in different studies[14,24,25]. One of the study isolated *Proteus* in male patients only[22], whereas *Proteus* was isolated equally in both male and female patients in this study.

In this study overall isolates were highly sensitive to amikacin (79.66%), nitrofurantoin (76.66%) and gentamicin (70.49%). *E. coli,* which was the most common isolate also showed similar sensitivity pattern: amikacin (84.09%), nitrofurantoin (83.95%) and gentamicin (74.07%). *E. coli* was most sensitive to nitrofurantoin (84.6%), amikacin (80.7%) and gentamicin (73%) in a different study[11], this sensitivity pattern is almost similar to our study. A study showed 100% and 94.7% of *E. coli* were sensitive to nitrofurantoin and amikacin respectively[15] whereas more than 80% of *E. coli* were sensitive to amikacin and nitrofurantoin in another study[26].

Only 34.28 % of overall organisms and 38.46% of *E. coli* were sensitive to ceftriaxone, one of the most commonly used antibiotic in UTI, in this study. However, study done by Shresthaet al[11] and Rai GK[27] et al showed only 10.2% and 36.3% of *E. coli* sensitive to ceftriaxone.

In our study, ampicillin, nalidixic acid and cotrimoxazole were the least effective antibiotics against overall isolate: 84.21%, 88.33% and 64.10% of *E. coli* isolates were resistant to ampicillin, nalidixic acid and co-trimoxazole respectively. Similarly, higher rates of resistance to ampicillin (91.6%), nalidixic acid (63.6%) and co-trimoxazole (66.6%) were reported in a previous study[15]. In our study, *E. coli* was resistant to nalidixic acid in 88.33% but study done by Chhetriet al[28] had shown only 40% of *E. coli* resistant to nalidixic acid.

Klebsiella showed 62.5% sensitivity to amikacin and 47.05% to nitrofurantoin in our study but Sharma et al[15] showed 100% sensitivity to amikacin and 83.3% to nitrofurantoin and Kumari et al[29] showed 96.0% of *Klebsiella* sensitive to amikacin. This variation in sensitivity pattern in *Klebsiella* may be either due to increasing resistance of organism or due to limited number of isolates.

Antibiotic sensitivity and resistance pattern vary over time and places. The study showed a high resistance to antimicrobials like ampicillin, co-trimoxazole and nalidixic acid and a possible reason could be these antibiotics were in general use for a long period. Among currently used antimicrobials empirically, aminoglycoside had relatively better sensitivity pattern to the bacterial isolates especially *E. coli*. An increasing resistance to third generation cephalosporin and fluoroquinolones is worrisome. A complete antibiotic sensitivity testing was not possible in all isolates which is a major limitation of this study. However, it still provides a glimpse of emerging antimicrobial resistance pattern.

CONCLUSION

E. coli is the most common microorganism causing UTI. Antimicrobial resistance has already emerged to all antimicrobials. None of the antimicrobials showed 100% sensitivity. Similarly antimicrobial susceptibility pattern vary in different regions and according to time. This makes empiric treatment of UTI difficult. Finally this type of study should be repeated periodically to assess the pattern of microorganisms causing UTI and their antimicrobial susceptibility which will guide in choosing antibiotics for the empiric treatment.

LIMITATIONS

This is a retrospective study. In some cases all the isolates were not tested against a particular antimicrobial because of unavailability of antimicrobials at the time of test performed.

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