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Uropathogens and their Culture Sensitivity Pattern in Children with Urinary Tract Infection

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ABSTRACT

Objective: To determine the frequency of bacteria causing Urinary Tract infections and their susceptibility to antibiotics in children of Sialkot.

Study Design: Cross-sectional study.

Place and Duration of Study: Department of Pediatrics Islam Teaching Hospital, Children Complex Hospital, and Islam Central Hospital, Sialkot Pakistan, from Jan to Dec 2020.

Methodology: All patients presenting with Urinary Tract infections, aged one month to 15 years were included in the study. Inclusion criteria were clinical suspicion of Urinary Tract infections and positive urine culture of a single bacterium. Antibiotic susceptibility was performed on all culture-positive samples.

Results: A total of 300 children were included, but 248 fulfilled the criteria of culture-positive Urinary Tract infections. Fifty-two children were excluded as they had non-pathogen growths, multi-organisms or were already on antibiotics. Gram-negative bacilli were most frequently isolated, accounting for 236(95.2%), whereas Gram-positive cocci comprised only 12 (4.8%) of cases. E. coli was the most frequent isolate among gram-negative rods, followed by Klebsiella, Proteus and Pseudomonas. All gram-negative rods were sensitive to Imipenem, whereas most were resistant to Ampicillin and TMP-SMX. Gram-positive cocci were sensitive to Vancomycin, Linezolid, Meropenem and Tazobactam.

Conclusion: Increasing resistance of uropathogens to commonly prescribed antibiotics is highly alarming. Therefore, the strategy of empirical treatment of Urinary Tract infections in children should be reevaluated based on regional studies.

Keywords: Antibiotics, Susceptibility, Uropathogens, Urinary tract infection.

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INTRODUCTION

Urinary tract infection (UTI) is one of the most common childhood infections. UTI occurs in 1% of boys and 1-3% of girls.[1] The prevalence of UTI varies with age. During 1st year of life, the male: female ratio is 2.8–5.4:1.[2] Beyond 1-2 years, there is a female preponderance, with a male: female ratio of 1:10.[3]

Short-term morbidity can arise from infection within the renal system and hematogenous spread, leading to urosepsis and meningitis. Long-term sequelae follow renal injury and scarring from upper urinary tract infection.[4] While serious infections in older children are less common, it is a common cause of occult and serious bacterial infection in neonates and infants.[5]

All major guidelines recommend Laboratory culture for UTI diagnosis.[6,7] Thresholds of bacteria vary between guidelines and collection methods. The American Academy of Pediatrics criteria for the diagnosis of UTI in children 2-24 months of age is the presence of pyuria and/or bacteriuria on urinalysis and at least 50,000 CFU/mL of a uropathogenic from the quantitative culture of a properly collected urine specimen.[8] Recent evidence suggests an even lower 10,000 CFU/mL threshold would slightly increase sensitivity without reducing diagnostic specificity.[9,10]

Knowing the spectrum of urinary pathogens and their susceptibility pattern is essential for physicians to identify the most suitable antibiotic in children. Our study aimed to determine the frequency of bacteria causing UTI, their susceptibility and their resistance pattern to various antibiotics in children of the Sialkot region.

METHODOLOGY

The multicenter cross-sectional study conducted from January to December 2020 at the Department of Pediatrics Islam Teaching Hospital, Children Complex Hospital, and Islam Central Hospital, Sialkot Pakistan. The study was approved by the Ethical Review Board (IMS/pharma/36314121/14/01/2021). The sample size was calculated using the WHO sample size calculator, keeping expected frequency of outcome factor as 82.3%.[11]

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Inclusion Criteria: Patients of either gender, up to 12 years of age presenting with symptoms of UTI and a positive urine culture of a single organism according to standard guidelines were included in the study.

Exclusion Criteria: Children whose sample grew multi-organisms or were already on antibiotics were excluded from the study.

Urine samples were collected by Quick-Wee technique from patients younger than two years old and in older children clean catch midstream urine, collected in sterile containers and sent to Laboratory. Samples were cultured on blood agar or MacConkey agar using a standard calibrated loop (0.01 mL), and the plates were incubated at 37°C for 24 hours. UTI was diagnosed based on≥105 CFU/mL of midstream urine or if there were 10,000 colonies of a single organism and the child had symptoms. After identifying bacteria, Kirby-Bauer disk diffusion performed an antibiotic susceptibility test based on Clinical and Laboratory Standards Institute 2013.[12]

Details of each patient were recorded, and data was analyzed using Microsoft Excel version 2016. Mean and standard deviation calculated for quantitative data. Frequencies and percentages were presented for qualitative variables.

RESULTS

In our study, 248 children with positive urine cultures were evaluated, of which 152(61.3%) were girls and 96(38.7%) were boys. The mean child age was 29.08±48.92 months. This study showed that the frequency of UTI in children was highest during the first year of life, which progressively decreases with age. In infants, 61 boys (24.6%) were affected, and 59 girls (23.8%) were, whereas between 1-5 years, a greater number of girls, 59(23.8%) were affected, and only 15(6%) boys were affected. (Table-I).

Table-I: Distribution of Children with UTI according to their Gender and Age Groups (n=248)

Age Group	<1 year n (%)	>1to<5 year n(%)	> 5 years n(%)	Total n(%)
Boys	61(24.6%)	15(6%)	20(8.1%)	96(38.%)
Girls	59(23.8%)	59(23.8%)	34(13.7%)	152(61.3)

Gram-negative bacilli were most frequently isolated among positive urine cultures, accounting for 236(95.2%) Among Gram-negative rods, E. coli was the most frequent isolate in 159(64.1%) urine samples, followed by Klebsiella, Proteus and Pseudomonas. Gram-positive cocci comprised only 12 (4.8%) of infections, and the commonest was Enterococcus faecalis (Table-II).

Table-II: Frequency of Gram Negative & Gram Positive Bacteria in Urine Culture (n=248)

Organism	Boys n(%)	Girls n(%)	Total n(%)
Acinetobacter spp	3(1.2%)	4(1.6%)	7(2.8%)
Citrobacter spp	1{0.4%)	1(0.4%)	2(0.8%)
Escherichia Coli	58(23.4%)	101(40.7%)	159(64.1%)
Enterobacter Cl	3(1.2%)	6(2.4%)	9(3.6%)
Enterocococcus fec	4(1.6%)	3(1.2%)	7(2.8%)
Coag ivestaphloccus	1(0.4%)	2(0.8%)	3(1.2%)
Klebseila Pneumon	10(4%)	14(5.6%)	24(9.6%)
Proteus Miribilus	10(4%)	13(5.2%)	23(9.2%)
Pseudomonas	5(2%)	7(2.8%)	12(4.8%)
Staphalococcus	1(0.4%)	1 (0.4%)	2(0.8%)
Grand Total	96	152	248

Table-III: Antibiotic Sensitivity Pattern in Gram Negative & Gram Positive Bacteria (n=248)

Antibiotics	E. Coli n-159	Klebseila n-24	Proteus n-23	Pseudomo n-12	Enterobac n-9	Acinatob n-7	Citrobact n-2	Enterococ n-7	Coa -& Staph n-5
Ampicilli	10(6.3%)	0(0.0%)	0(0.0%)	0(0.0%)	1(2.3%)	0(0.0%)	0(0.0%)	1(1.8%)	1(0.4%
Amoviclav	26(16.5%)	0(0.0%)	2(1.7%)	0(0.0%)	2(4.5%)	0(0.0%)	0(0.0%)	2(3.6%)	1(0.4%
SMX-TMP	19(12.0%)	2(2.1%)	2(1.7%)	0(0.0%)	2(4.5%)	0(0.0%)	0(0.0%)	1(1.8%)	1(0.4%
Amikacin	140(88.6%)	18(18.6%)	20(17.4%)	8(16.0%)	8(18.2%)	4(26.7%)	2(28.6%)	6(10.9%)	5(15.4%)
Ciproflox	62(39.2%)	11(11.3%)	9(7.8%)	3(6.0%)	3(6.8%)	0(0.0%)	0(0.0%)	4(7.3%)	2(0.0%
Ceftazidim	71(44.9%)	8(8.2%)	14(12.2%)	9(18.0%)	2(4.5%)	1(6.7%)	1(14.3%)	NT	NT
Cefixime	36(22.8%)	4(4.1%)	6(5.2%)	2(4.0%)	2(4.5%)	0(0.0%)	0(0.0%)	NT	NT
Ceftriaxo	52(32.9%)	6(6.2%)	11(9.6%)	4(8.0%)	2(4.5%)	1(6.7%)	0(0.0%)	NT	NT
cefotaxim	52(32.9%)	6(6.2%)	8(7.0%)	4(8.0%)	2(4.5%)	1(6.7%)	0(0.0%)	NT	NT
Imepenem	159(100.0%)	24(24.7%)	23(20.0%)	12(24.0%)	9(22.7%)	7(46.7%)	2(28.6%)	NT	NT
Nitrofura	134(84.8%)	18(18.6%)	20(17.4%)	8(16.0%)	9(22.7%)	1(6.7%)	2(28.6%)	6(10.9%)	3 (7.7%)
Vancomy	NT	NT	NT	NT	NT	NT	NT	7(12.7%)	5(15.4%)
Linezolid	NT	NT	NT	NT	NT	NT	NT	7(12.7%)	5(15.4%)
Carbapen	NT	NT	NT	NT	NT	NT	NT	7(12.7%)	5(15.4%)
Meropenm	NT	NT	NT	NT	NT	NT	NT	7(12.7%)	5(15.4%)
Tazobact	NT	NT	NT	NT	NT	NT	NT	7(12.7%)	5(15.4%)

(n=number, NT= Not tested)

Gram-negative isolates were highly sensitive to Imipenem, Amikacin and Nitrofurantoin, but a high degree of resistance was noted against Ampicillin, Amoxiclav and TMP-SMX. However, an increasing resistance pattern was also noted against 3rd generation Cephalosporins and Ciprofloxacin (Table-III).

DISCUSSION

Our study observed that the overall frequency of UTI was lower among males (38.7%) compared to females (61.3%). Similarly, other data have suggested that 8% of girls have a symptomatic UTI during childhood and that the frequency of a first-time UTI in boys older than two years is probably less than 1(0.5%). A study conducted in Lahore by Naz *et al*.[12] found the incidence of UTI was the same among males (49.9%) and females (50.9%), and similarly, a study in Iran has reported almost similar results, i.e. 47.2% and 52.8% in males and females respectively.[13] In our study, organisms isolated were 95.2% gram-negative and 4.8% were gram-positive, which were almost similar to previous studies.[14,15] In the present study, E. coli (64.1%) was the commonest pathogen which was in accordance with other studies.[16,17] However, in contrast to our study, some studies documented that Klebsiella pneumoniae is the most common uropathogenic among children.[18,19]

Other Gram Negative isolates in our study were Klebsiella pneumoniae (9.6%), Proteus mirabilis (9.2%), Pseudomonas aeruginosa (4.8%), Enterobacter cloacae (3.6%), Citrobacter spp (0.8%) and Acinetobacter spp (2.8%), which was unlike another study.[11] The Gram-positive isolates were Enterococcus faecalis (2.8%), Coagulase negative Staphylococcus (1.2%) and Staphylococcus Aureus (1.2%).

Antibiotic susceptibility pattern of pathogens isolated showed high resistance by almost all Gram Negative and Gram Positive organisms against commonly prescribed antibiotics, including Ampicillin, Amoxiclav, and TMP-SMX. In contrast, an increasing resistance trend was also noted against 3rd generation Cephalosporins and Ciprofloxacin. It was almost similarly reported by another study in which almost 70% of Klebsiella pneumoniae and E. coli were resistant to commonly available antibiotics.[20]

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LIMITATIONS OF STUDY

Despite all efforts, certain limitations exist in this study. First, the urine culture and sensitivity data were of children, thereby cannot apply to all UTI patients. Secondly, data was primarily focused on urine culture findings. Therefore, epidemiologic and demographic characteristics and comorbid conditions of patients are not extensively described. However, it was considered a useful study regarding prevailing uropathogens and emerging antibiotic resistance.

CONCLUSION

It is concluded that high resistance to pathogens is associated with inappropriate infection control practices and unwarranted use of antibiotics. Therefore, guidelines for empiric treatment of UTI should be reevaluated periodically based on regional studies. Regular surveillance of emerging resistance of uropathogens to antibiotics is necessary to reduce morbidity in children with UTIs.

Conflict of Interest: None.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

MMJ: & AA: Data acquisition, data analysis, drafting the manuscript, approval of the final version to be published.

AS: & JJ: Study design, drafting the manuscript, data interpretation, concept, approval of the final version to be published.

SM: & MM: Critical review, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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