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ORIGINAL ARTICLE

Frequency and Susceptibility Profile of Pathogens Causing Urinary Tract Infections in Pediatric Population

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ABSTRACT

Background: Urinary tract infection is one of the most common cause of bacterial infection in childhood. Urinary Tract Infections are more common in pediatric population and is a major reason behind morbidity and mortality in children.
Aim: To isolate most common pathogens causing UTI, their frequency and susceptibility pattern in pediatric population.
Methodology: Urine samples were collected from various children with symptomatic UTI and cultured on Cysteine lactose electrolyte deficient agar. Identification of organisms was done by using microbiological techniques which included biochemical tests and gram staining. Antibiotic susceptibility pattern was achieved by Kirby Bauer disc diffusion method and results were interpreted according to Clinical Laboratory Standard Index guidelines 202.
Results: Total 1200 samples were processed. Out of these samples, 492(41%) had positive bacterial growth and 59% had negative growth. Common pathogens isolated were *Escherichia coli* 209(42.5%), *Klebsiella spp* 144(29.3%), *Pseudomonas spp* 47 (9.6%), *Enterococcus faecalis* 38 (7.7%), *Acinetobacter spp* 37(7.5%), and *Proteus spp* 17 (3.5%). Overall these uropathogens exhibited better susceptibility for Colistin (84.8%), followed by Nitrofurantoin (64.7%), Amikacin (64%), Pipedemic acid 25.4%), Ceftazidime (21.4%), Nalidixic acid (18.7%), Augmentin (16.8%) and Meropenem (54%).
Conclusion: This study reported a high rate of UTIs (41%) among children. A high proportion of antibiotic resistant is due to overuse of antibiotics. Incidence of UTIs can be decreased with prompt diagnosis at the right time and empirical antibiotic therapy.
Keywords: Urinary Tract infection, *Escherichia coli*, antimicrobials.

INTRODUCTION

Urinary tract infection is one of the most common cause of bacterial infection in childhood. Worldwide each year, about 150 million urinary tract infections are reported[2].UTIs more common in pediatric population and is a major reason behind morbidity and mortality in children, the rate of incidence differs according to race, gender and age of children[13]. It is calculated that overall symptomatic Urinary tract infections results in maximum 7 million visits to outpatient department, one million visits to emergency departments and 100,000 hospitalizations annually[14.] The reported incidence of Urinary tract infection is 7% and 2% among girls and boys respectively[11]. The factors that tend to effect the rate of Urinary tract infections are influenced by time, gender, age of the patients and geographical location with considerable variation among them. Any organism found in the urinary tract can be a cause of UTI but mostly pathogens belong to enterobacteriaceae family containing facultative anaerobic, gram negative organisms[9].
Urinary tract infection is defined as the pathogenic colonization of the areas of urinary tract that are sterile otherwise (i.e., kidneys, ureters, bladder, proximal urethra)[18].

Most important step in pathogenesis of urinary tract infection is adherence and then colonization of enteric pathogens in urethra. Through urethra bacteria ascends to bladder. It is the result of complex host pathogen interactions that decide whether uropathogens are successful incolonization or eliminated.

Although viruses and fungi can cause UTI but bacteria are the most prominent cause of UTIs. The list of pathogens causing Urinary tract infections is as follows: *Escherichia coli, Pseudomonas species, Klebseilla species, Staphylococcus species, Streptococcus species, Chlamydia trachomatis, Candida albicans etc*

At the present time, antibiotic resistance is increasing due to lack of proper care and excessive use of antibiotics specifically in children with recurrent UTI. The proper detection of infectious agents, their sensitivity and resistance patterns to various antibiotics plays vital roles in diagnosis and appropriate treatment of Urinary tract infections.

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The objective of present study was to observe the frequency of pathogens causing Urinary Tract Infections and their susceptibility pattern in pediatric population in Children hospital.

MATERIAL AND METHODS

This research was a retrospective study on 1200 children with symptoms of UTI admitted in different pediatric wards of Children Hospital Lahore. Urine samples were taken from different wards of The Children's Hospital and The Institute of Child Health, Lahore from September 2019 to February 2020 after an institutional ethical approval. Samples of urine for bacteriological examination were obtained by mid- stream clean catch method. The specimens were collected in containers, labeled and then sent to the laboratory for further processing. **Cystine lactose electrolyte-deficient (CLED) agar** was used to culture urine sample**s** as to isolate urinary pathogens. A sterile wire loop was used; one that can hold upto(0.002 ml), a loopful of urine was inoculated on a quarter plate of CLED agar. The plate was incubated at 35–37°C overnight in aerobic environment. The CLED agar culture was examined and was reported as followed: Significant bacteriuria was considered with a growth of $\geq 10^5$ colony forming units/mL, Less than 10^4/ml, not significant and 10^4–10^5/ml, doubtful significant. Identification of bacteria was done by different methods which included observing their morphology on culturing media and then conforming with definitive biochemical tests. Antimicrobial sensitivity was done on Mueller-Hinton agar medium by using Kirby-Bauer Disk Diffusion method on culture positive urine samples with significant bacteriuria. Different antibiotics tested included (those that were available at that time in the laboratory, due to limited stock some antibiotics were not tested) Amikacin (AK), Cefixime (CFM), Cefotaxime (CTX), Augmentin (AMC), Colistin (CT), Polymixin B (PB), Meropenem (MEM), Ceftazidime (CAZ), Ceftriaxone (CRO), Sulbactam-Cefoperazone (SCF), Ciprofloxacin (CIP), Piperacillin-tazobactam (TZP), Cefuroxime (CXM), Imipenem (IPM), Trimethoprim-sulfamethoxazole (SXT), Fosfomycin (FOS), Nitrofurantoin (NIT), Nalidixic acid (NA), Norfloxacin (NOR). The interpretation of susceptibility results were confirmed according to the Clinical and Laboratory Standard Institute (CLSI) guidelines 2021.

Data collected in proforma was entered. The variables included patient gender, different wards, pathogens and different antibiotics. Statistical analysis and calculations were done using the IBM SPSS statistics 25.0 Software. Categorical variables were expressed in frequency and proportions. All the statistical tests were performed at the 5 % level of significance.

RESULTS

Out of 1200 samples, 492 (41%) had positive bacterial growth and 708 (59%) showed no growth. The majority of positive cultures were of male patients 293(60.9%) followed by female patients 188 (39.1%) (Figure 1). Maximum positive urine cultures were between the ages of 6-10 years followed by 0-5 years. (Figure 2)

The susceptibility was high for Colistin (84.8%), followed by Nitrofurantoin (64.7), Amikacin (64%), Pipedemic acid 25.4%), Ceftazidime (21.4%), Nalidixic acid (18.7%) and Co-amoxiclave (16.8%) (Figure 3).

The most of the isolated positive cultures were from Nephrology ward 156 (32.4%) followed by Urology ward 95 (19.8%), OPD 93(19.3%), Medical wards 71(14.8%), Emergency wards 23 (4.8%) Cardiac Surgery ward 17(3.5%), Haem/ Onco 10(2.1%), Neurology ward 6 (1.2%), Gastrology 6(1.2%) and Plastic surgery wards 4 (0.8%) (Table 1).

Table 1: Frequency of positive Bacterial growth in children according to different Wards

Wards	Frequency	%age
Nephrology	156	32.4
Urology	95	19.8
Opd	93	19.3
Medical 1-4	71	14.8
Emergency	23	4.8
CSICU	17	3.5
Haem/Oncology	10	2.1
Others	16	3.2
Total	481	100

Table 2 : Frequency of Bacterial isolates in Urinary tract infection

Organisms	Frequency	%age
Escherichia coli	202	42.0
Klebsiella spp.	140	29.1
Pseudomonas spp.	87	18.1
Acinetobacter	20	4.2
Enterococcus. faecalis	18	3.7
Citrobacter spp.	09	1.9
Proteus spp.	05	1.0
Total	481	100

Fig. 1: Graphical representation of frequency distribution of isolated organisms in gender

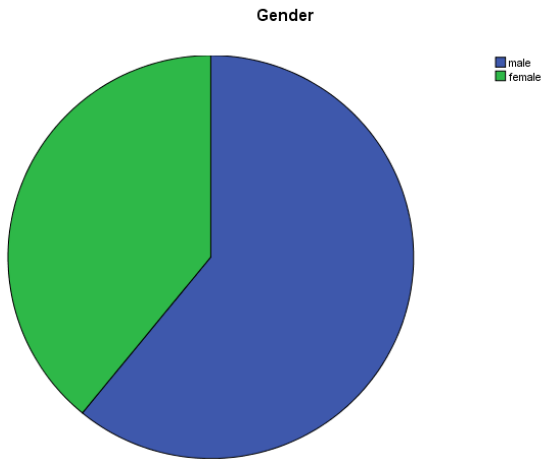
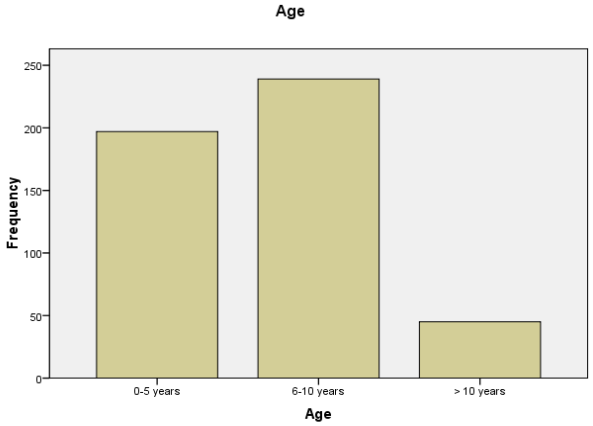
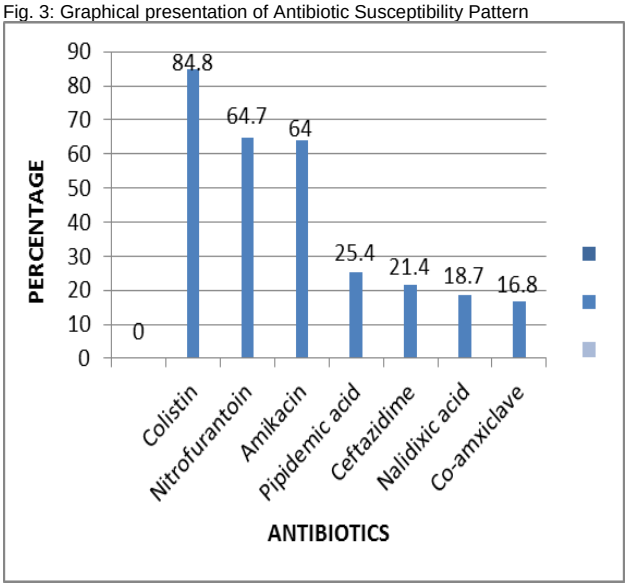


Fig. 2: Graphical representation of frequency of positive urine culture among patients of different age



Among positive cultures 454 (93.3%) bacterial isolates were gram negative and 18(7.7%) were gram positive. The most commonly isolated bacteria were *Escherichia coli* 209(42.47%) followed by *Klebsiella spp.* 144(29.3%), *Pseudomonas spp.* 47(9.6%) and *Acinetobacter spp.* 37(7.5%) and *Proteus spp.* 17 (3.5%). The only gram positive bacteria isolated were *Enterococcus faecalis* 38(7.7%) (Table 2).

Fig. 3: Graphical presentation of Antibiotic Susceptibility Pattern



DISCUSSION

In urinary tract infections urinary tract can be infected along with kidneys (pyelonephritis), bladder (cystitis) and urethra. Normally in children UTI occurs due to ascending infection mainly in the first year of life hematogenous spread may occur. It is one of the frequent infection in young children, as symptoms are nonspecific it is difficult to diagnose. For prompt recovery and avoidance of complications rapid and befitting antimicrobial treatment should be used. Delayed or inaccurate antibiotic treatment may result in recurrence, especially in children with renal abnormalities.

In present study an attempt was made to know the frequency of various bacterial pathogens accountable for urinary tract infections. In the present case total positive cultures were 492/1200 (41%) whereas *Escherichia coli* was the major etiological agent causing UTI.96.2% of the isolates in the study was gram

negative organisms. Most common uropathogens isolated were. *E. coli* was by far the most common bacteria isolated in both outpatients and inpatients showing highest frequency of (42.5%), followed by *Klebsiella spp* (29.3%) The study was comparable to the study conducted in Nepal in which out of the 1680 urine samples, 1205 (71%) showed significant bacteriuria, while *E. coli* was the predominant and produced a frequency of 59.4%[4].

In the present study most of the positive cultures were obtained from male patients 293(60.9%) followed by female patients 188(39.1%). The results were similar to other studies[17]which showed that boys had significant higher prevalence (11.4%) than girls (11.2%). However in a study conducted at Government General Hospital, Tirupati, the incidence of UTI was significantly higher in girls 58 (83%) than boys 12(17%)[10].

In the present study the majority of the isolated positive cultures were from Nephrology ward 156(32.4%) followed by Urology ward 95 (19.8%), OPD 93(19.3%) and others.

In the ongoing study it was found that among the tested antibimicrobial drugs for various pathogens Nitrofurantoin (64.7%) was the most sensitive antibiotic followed by Amikacin (64%), Pipedemic acid (25.4%), Ceftazidime (21.4%), Nalidixic acid (18.7%) and Co-amoxiclav/ Augmentin (16.8%). However in a study done in Ethiopia pathogens showed high sensitivity to Ciprofloxacin (62.68%), Norfloxacin (61.08%) and Nitrofurantoin (50.49%) while they showed resistant to most antibiotics such as Amoxicillin (85.12%), Ampicilin (81.22%) and Tetracycline (80.2%)[7].

E. coli was the frequent pathogen isolated in current study and its sensitivity pattern was as followed:Nitrofurantion (93.6%), Fosfomycin (81%), Amikacin (78.7%), Meropenem (68.3%), Pipedemic acid (17.8%), Co-Amoxiclave (22.8%) respectively. However in a previous study *E.coli* was most prevalent pathogen isolated and showed highest susceptibility to amikacin (98%) followed by Gentamicin (87.9%), Ceftazidime (80.8%), Norfloxacin (78.4%) and Cotrimoxazole (77.9%) [4].

Second to *E. coli* was *Klebsiellaspp* which showed highest sensitivity to Nitrofurantoin and Amikacin (15.2%), least to Pipedemic acid (7.3%), Nalidixic acid (6.7%) and Ceftazidime (4.2%) in the present research. However in a previous study in Nigeria, showed the following pattern for *Klebsiella spp*: Ciprofloxacin and Nalidixic acid (88.8%), Nitrofurantoin (44.4%), Gentamycin (55.6%) and Augmentin (22.2%) respectively[2].

Acinetobacter was found to be the most resistant microbe isolated with least sensitivity to Amikacin, Augmentin, Ceftazidime (1%), Nitrofurantoin and Pipedemicacid(0.6%) respectively. Pseudomonas spp which was also a common cause of nosocomial UTI, showed some sensitivity to Amikacin(20.1%), Ceftazidme (13.8%), Meropenem (13.4%), Nalidixic acid (10.4%) and Nitrofurantoin (9.7%) respectively. Other minor pathogens isolated were *Citrobacter* and *Proteus* showing sensitivity to Amikacin, Augmentin Ciprofloxacin Nitrofurantoin and Pipedemic acid.

The only isolated gram positive pathogen was Enterococcus faecalis in the present study. It showed highest sensitivity to linezolid (88.9%), then Nitrofurantoin (61.1%), vancomycin 95%) and was least sensitive to Augmentin (16.7%), Amikacin (11.1%) and gentamycin (0%) respectively.

CONCLUSION

This study showed a high rate of UTIs (41%) with low susceptibility to commonly used antimicrobials among uropathogens. Rational use of antimicrobial drugs and good infection control efforts are required to affectively handle the spread of resistant bugs in the pediatric patients.

Limitations: The present study was done in pediatric patients of a single tertiary care pediatric hospital. Sample size was relatively smaller compared to the huge population of Pakistan. The study did not isolate strict anaerobic bacteria and fungi, which could have raised the number of bacterial isolates reported as negative growth.

Conflict of interest Disclosures: None
Grant Support & Financial Disclosures: None

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