Original Article

Bacteriological Spectrum of Pediatric Urinary Tract Infection and Its Drug Sensitivity and Resistance Pattern

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[1] Conception of study
[1] Experimentation/Study conduction
[1,2,3,4,5,6] Analysis/Interpretation/Discussion
[2,6] Manuscript Writing
[2,5] Critical Review
[2,3,4,5] Facilitation and Material analysis

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Article Processing
Received: 03/11/2021
Accepted: 03/06/2022

Cite this Article: *Mumtaz, N., Humayoun, Q.S.., Liaquat, I., Mehmood, T., Hafeez, M., Zeb, H. Bacteriological Spectrum of Pediatric Urinary Tract Infection and Its Drug Sensitivity and Resistance Pattern. Journal of Rawalpindi Medical College. 30 Sep. 2022; 26(3): 402-407.*
DOI: https://doi.org/10.37939/jrmc.v26i3.1823

Conflict of Interest: *Nil*
Funding Source: *Nil*

Access Online:

Abstract

Introduction: Urinary tract infection (UTI) is a common infection in children. It has high morbidity and long-term sequelae.

Objective: To determine the frequency of bacteriological organism of Pediatric UTI and its drug sensitivity and resistance pattern and to improve the treatment of UTI according to culture sensitivity, hence minimizing the resistance pattern and disease burden.

Materials and Methods: It was a descriptive cross-sectional study conducted in 2018 over a period of 6 months. A total of 225 children with UTIs were enrolled. Urine culture and sensitivity reports were evaluated and an isolated microorganism along with their sensitivities to the mentioned drugs was entered through designed Performa.

Results: The average age of the children was 7±.18 years. Common bacteriological agents leading to UTI were E.Coli (59.1%), followed by Pseudomonas aeruginosa (14.2%), Klebsiella (13.8%), staphylococcus aureus (8.9%), and enterococcus (4%).

The most common organism isolated was E.coli (133 cultures). It was fully resistant to amoxicillin-clavulanate and ofloxacin (100%), while the resistance pattern with other antibiotics was ceftriaxone (88.7%), imipenem (88.7%), and ciprofloxacin (75.9%). The most effective antibiotic for E.coli was amikacin (81.2%). Pseudomonas aeruginosa was the second most common isolate (32 cultures). Its drug resistance pattern was amikacin (84.4%), amoxicillin & clavulanate (90.6%), imipenem (100%), and ofloxacin (100%).

Conclusion: A most common organism that causes UTI was E.coli followed by Pseudomonas Aeroginosa and Klebsiella. These isolates were highly resistant to commonly used antibiotics. Therefore new antibiotics policy should be adopted to treat these infections.

Keywords: Urinary tract infection, E.coli, Bacteriological organism.

Introduction

UTI is a common infection in children. It has high morbidity and long-term sequela and can occur in all age groups, especially in the pediatric age group. It occurs in 1-3% of females and 1% of males by 10 years of age.[1] E. Coli (71.4%), and Klebsiella spp. (9.6%) are common organisms that cause UTIs. While less common causes include Enterococcus fecal (6.4%), Pseudomonas aeruginosa, Staphylococcus aureus, Serratia spp, Enterobacter spp, and Proteus.[2,3,4] Both clinical features and urinalysis help in diagnosis. However gold standard for diagnosis of UTI is urine culture having $>10^5$ organisms per ml of urine.[5] Its sensitivity yield is roughly up to 18%.[6] Drug sensitivity and resistance patterns are measured by the standard disc diffusion method. Treatment of UTIs includes empirical oral treatment for uncomplicated UTIs and intravenous treatment for complicated UTIs and later on, culture-based.[7] Over the past decade, the multi-drug resistance of organisms causing UTIs is alarmingly increasing. A study by Rezaee et al confirms the presence of multi-drug resistant organisms causing UTIs. In this study drug sensitivity patterns of E.coli were ciprofloxacin (15%), Nitrofurantoin (11%), nalidixic acid (25%), and 30 to 75% for amikacin, gentamicin, ceftriaxone, ceftazidime, cefotaxime, and co-trimoxazole.

The sensitivity pattern of E.coli was very low [8] for ciprofloxacin (15%), Nitrofurantoin (11%), nalidixic acid (25%), and 30 to 75% for amikacin, gentamicin, ceftriaxone, ceftazidime, cefotaxime, and co-trimoxazole. Over all ciprofloxacin and amikacin were highly effective against gram-negative and gram-positive organisms.[2,4]

In another study conducted in Pakistan, Pseudomonas aeruginosa was isolated in 254 cultures (5.4%). It was highly resistant to commonly used antibiotics, Augmentin (97.6%), Nalidixic acid (98.8%), Cefuroxime (99.2%), Cotrimoxazole (99.2%), and Amoxil/Ampicillin (99.6%).[9] However gram-negative organisms showed better sensitivity to antibiotics like Amikacin (63%), Cefotaxime (55%), Amoxicillin (49%), and Ciprofloxacin (49%). While drug sensitivity pattern of gram-positive organisms was 66.6% for Chloramphenicol, Co-trimoxazole, Gentamicin, Amikacin, Ciprofloxacin, and Cefotaxime. However, the drug sensitivity pattern was 33.3% with Ampicillin, Amoxicillin, Tetracycline, and Norfloxacin.[11] Untreated UTI leads to renal parenchymal damage which in turn leads to chronic renal failure and secondary hypertension esp. in a patient having urinary tract anomalies i.e. vesicoureteric reflux.[1]

To adopt a new antibiotic policy in the scenario of changing drug resistance patterns, this study is designed to know the current bacterial spectrum of UTI and its drug sensitivity and resistance pattern in our unit.

Materials and Methods

It was a Descriptive Cross-sectional with a non-probability consecutive sampling technique, conducted over a period of 6 months in the Indoor and outdoor department of Paediatric Holy family hospital, Rawalpindi in Children ranging between 2 to 10 years of age.

Patients who are confirmed cases of UTI based on Urine C/S reports were enrolled. Those who have taken any antibiotic before urine c/s and who are diagnosed to have any secondary infections were excluded. All the patients fulfilling the inclusion criteria were included in the study. Midstream urine samples were taken under absolute aseptic measures. The collected samples were transported immediately to the laboratory for urinalysis, culture, and sensitivity. Cultures were done directly on CLED agar medium for 48 hours. Sensitivities were checked for Trimethoprim-sulfamethoxazole, Amoxycillin/ Clavulanic acid Nalidixic acid, and others. Basic demographic information including name, age, gender, weight, and height was collected. Urine culture and sensitivity reports were evaluated and isolated microorganisms along with their sensitivities to the mentioned drugs were entered in already designed Performa. All the information collected was entered into SPSS version 20.0 and was analyzed through its statistical package. Frequencies with percentages were calculated for categorical variables like gender, pathological type of microorganism, socio-economic status, residence, sensitivity, and resistance. For continuous variables like age, weight, and height, the mean with standard deviation was calculated. Effect modifiers like age, gender, weight, and height were controlled by stratification. Post-stratification chi-square was applied. P value <0.05 was significant.

Results

A total of 225 children with UTIs enrolled for the study. Their mean age was 7±.18 years. Their average

height and weight along with mean age are presented in Table 1.

There were 155 (68.99%) male and 70 (31.11%) female. Most of the children belong to middle-class families (58.11%). Out of 225 children, 123 (54.67%) were from urban and 102(45.33% were from rural areas. A total of 225, 196(87.11%) children had gram-negative organisms and 29(12.89%) had gram-positive organisms.

Common bacteriological agents leading to UTI were E.Coli (59.1%), followed by Pseudomonas aeruginosa (14.2%) and klebsiella (13.8%)as presented in Figure 1.

The drug sensitivity and resistance pattern for gram-negative organism is shown in Table 2 and 3. The drug resistance pattern of E.coli was amoxicillin-clavulanate (100%), ceftriaxone (88.7%), imipenam (88.7%), ciprofloxacin (75.9%), and ofloxacin (100%). the most effective antibiotic for e.coli was amikacin (81.2%). Pseudomonas aenroginosa was the second most common isolate (32 cultures). Its drug resistance pattern was amikacin (84.4%), amoxicillin-clavulanate (90.6%), imipenam (100%), and ofloxacin (100%). Klebsiella was the third most common isolate (31 cultures). The drug resistance pattern was ceftriaxone (87.1%), ciprofloxacin (100%), and ofloxacin (100%). Staphylococcus aurus was the fourth most common isolate (20 cultures). Its drug resistance pattern was imipenam (80%), ciprofloxacin (85%), and ofloxacin (85%). Enterococcaii is isolated into 9 cultures. Its drugs resistance pattern was amikacin (88.9%), amoxicillin-clavulanate (100%), ceftriaxone (89%), trimethoprim-sulfamethoxazole (89%), and ofloxacin (88%).

Stratification analysis was performed and observed that the rate of E.coli and klebsiella was significantly high above 5 years of age children while other organisms were not statistically significant among different age groups as presented in Table 4.

Table 1: Descriptive Statistics of Characteristics of Patients (n=225)

Variables	*Mean*	*Std. Deviation*	*95% Confidence Interval for Mean*	
			Lower Bound	*Upper Bound*
Age (Years)	7.00	2.18	6.72	7.29
Weight (kg)	27.89	8.91	26.72	29.06
Height (cm)	128.23	19.32	125.69	130.77

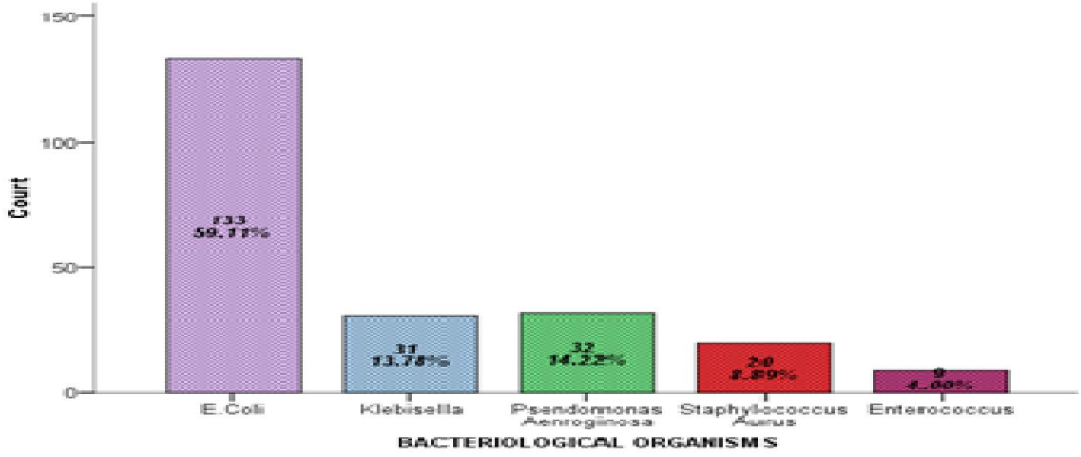

Figure 1: Frequency of Bacteriological Organism of Paediatric Patients with UTI (n=225)

Table 2: Drug Sensitivity and Resistance Pattern for Gram Negative Organism of Paediatric Patients with UTI (n=255)

Antibiotics	*E. Coli n=133*		*Klebsiella n=31*		*Psendomonas Aenroginosa n=32*	
	Sensitive	Resistant	Sensitive	Resistant	Sensitive	Resistant
Amikacin	81.2%	18.8%	25.8%	74.2%	15.6%	84.4%
Amoxicillin Clavulanate	0%	100%	NT		9.4%	90.6%

Ceftriaxone	11.3%	88.7%	12.9%	87.1%	NT	
Nalidixic acid	36.1%	63.9%	NT		NT	
Trimethoprim-sulfamethoxazole	NT		NT		21.9%	78.1%
Imipenam	11.3%	88.7%	NT		0%	100%
Ciprofloxacin	24.1%	75.9%	0%	100%	NT	
Ofloxacin	0%	100%	0	100%	9.4%	90.6%

Table 3: Drug Sensitivity and Resistance Pattern for Gram-Positive Organism of Paediatric Patients with UTI (n=255)

Antibiotics	*Staphylococcus Aurus n=20*		*Enterococcus n=9*	
	Sensitive	**Resistant**	**Sensitive**	**Resistant**
Amikacin	25%	75%	11.1%	88.9%
Amoxicillin Clavulanate	NT		0%	100%
Ceftriaxone	NT		11%	89%
Nalidixic acid	NT		NT	
Trimethoprim-sulfamethoxazole	35%	65%	11%	89%
Imipenam	20%	80%	22%	78%
Ciprofloxacin	15%	85%	21	79%
Ofloxacin	15%	85%	12%	88%

Table 4: Frequency of Bacteriological Organism of Paediatric Patients with UTI By Age Groups

Organism	*Age Groups (Years)*			*P-Value*
	2-4	**5-7**	**8-10**	
	n=27	**n=92**	**n=106**	
E.Coli	8(29.6%)	62(67.4%)	63(59.4%)	0.002
Klebisella	8(29.6%)	7(7.6%)	16(15.1%)	0.012
Psendomonas Aenroginosa	3(11.1%)	16(17.4%)	13(12.3%)	0.521
Staphylococcus Aurus	5(18.5%)	5(5.4%)	10(9.4%)	0.106
Enterococcal	3(11.1%)	2(2.2%)	4(3.8%)	0.113

Discussion

Bacteriological infections are the leading cause of morbidity and mortality among the paediatric age group.[12] Generally UTI has a benign course in adults but in children, it can result in marked morbidities like hypertension and renal failure due to inconspicuous clinical manifestations.[13] Empirical treatment for UTIs normally failed nowadays due to resistance of urinary pathogens, that's why effective antibiotics are very important. Early information regarding appropriate antibiotics will lead to effective treatment, will lessen hospital stays, and prevent outbreaks as well.[14,15] Incidence of UTI varies according to age and gender with more susceptibility of females due to physiologic and anatomic mechanisms.[16,17] In our study there were 155 (68.99%) male and 70 (31.11%) female patients. This might be due to gender preference in our society.[18]

Gram-negative bacteria are one of the important causes of urinary tract infection among them E-coli being the most common.[19] Apart from gram-negative bacteria, gram-positive bacteria like staphylococcus spp., and streptococcus spp. are also being reported.[17,20] In our study 196 (87.11%) children had UTIs due to gram-negative organisms and 29 (12.89%) due to gram-positive organisms. Common bacteriological agents leading to UTI were E.Coli (59.1%), followed by Pseudomonas aeruginosa (14.2%), Klebsiella (13.8%), staphylococcus aureus (8.9%), and enterococcus (4%). Hussain et al and Pandit et al reported similar patterns in their studies.[21,22] But in another study Fenta et al reported klebsiella Spp. as a common organism causing UTIs in children.[16]

Over the last decade, antibiotic resistance to uropathogens is alarmingly increasing.[23] Amin et al and woo et al observed high resistance to commonly used antibiotics. E-coli isolates mainly responded to amikacin (18.8% resistant).[24] Gunduz et al reported

amikacin being the most sensitive drug in UTIs.[24,25] One of the problems in clinical practice is resistance to pseudomonas aeruginosa and its predominance among immunocompromised patients.[26] In our study pseudomonas aeroginosa was isolated in 32 cultures and the most resistant drugs were imipenam (100%) and ofloxacin (100%) followed by amikacin (84.4%) and amoxicillin-clavulanate (90.6%). The resistance to ampicilin was 45%, 50%, and 100% in Canada, Europe, and Africa respectively.[26,27] In the present study resistance to ampicillin/amoxicillin was very high with all the gram-negative and positive bacteria.

Due to the prevalence of multidrug-resistant organisms in UTIs it is suggested that appropriate antibiotics should be administered to lessen the chances of resistance.

Every county must have its own epidemiological data, and guidelines for the treatment of UTIs in paediatrics. So appropriate antibiotic cover and prophylaxis should be given. Some leading treatment centres must identify uropathogens causing UTIs and their culture sensitivity pattern should be studied. These parameters can help form guidelines in treatment to decrease the chances of resistance.

Conclusion

E. Coli is the most common cause of UTI in children followed by Klebsiella. Bacterial organisms isolated in this study are highly resistant to commonly used antibiotics.

There is a need to review the antibiotics policy. Irrational and unsupervised use of antibiotics should be discouraged.

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