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Original Research Article

Prospective study of clinical, microbiological and antibiotic sensitivity profile of community-acquired paediatric culture-positive urinary tract infection in a tertiary care hospital in central Kerala

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ABSTRACT

Background: Childhood urinary tract infections (UTIs) require early diagnosis and treatment to prevent recurrence and renal scarring. A local antibiogram is crucial for selecting empiric antibiotic treatment until culture reports are available. This study analyzed the clinical presentation, organism spectrum, and antimicrobial sensitivity in pediatric UTIs, including multidrug-resistant extended-spectrum beta-lactamase (MDR ESBL) occurrence, in a central Kerala tertiary care hospital.
Methods: This prospective study included 93 culture-positive pediatric UTI cases from children aged one month to 16 years. We analyzed clinical presentations, organism spectrum, and antimicrobial sensitivity in two age groups: under 5 years and 5 years and older. Data were statistically analyzed using appropriate methods.
Results: Of the 93 cases, 83.9% were in the 1 month to <5 years group, and 16.1% were in the 5 to 16 years group. Fever was present in 90.3%, dysuria in 26.88%, and increased frequency of micturition in 9.6%. *E. coli* was the most common organism (58.1%), particularly in the younger group. Non-*E. coli* organisms predominated in the older group. Sensitivity rates were 93.5% for amikacin, 84.9% for piperacillin-tazobactam, and 90.3% for meropenem. MDR ESBL prevalence was similar in both age groups (43.6%).
Conclusions: UTIs are more common in children under 5 years, with *E. coli* being the predominant cause. In children over 5 years, non-*E. coli* organisms are more frequent. Amikacin is the preferred first-line IV antibiotic, followed by piperacillin-tazobactam and meropenem. Amoxyclav is recommended for oral treatment, except in cases involving non-*E. coli* in children over 5 years.

Keywords: Urinary tract infection, Extended spectrum beta lactamase, Multidrug resistant, *E. coli*, Non *E. coli*

INTRODUCTION

Urinary tract infection (UTI) is a common infection among children.[1-3] Diagnosing UTI through history and physical examination alone can be challenging due to the often-nonspecific presentation[1,3,4] Early diagnosis and appropriate treatment are crucial to prevent recurrence and renal scarring.[1,5] The organism spectrum and antibiogram for pediatric UTIs vary geographically. While *E. coli* remains the most common pathogen, there is an increasing prevalence of MDR ESBL bacteria, complicating treatment options.[2,4] A local antibiogram is essential for guiding empiric antibiotic therapy until culture results are available.

This prospective study was conducted to analyze the organism spectrum, antimicrobial sensitivity, and clinical presentation of community-acquired pediatric UTIs in

two age groups (<5 years and 5 years and older) from a tertiary care hospital in central Kerala.

METHODS

This prospective analytical study included children aged 1 month to 16 years with community-acquired culture-positive UTIs, diagnosed in the pediatric department of Rajagiri hospital, Aluva, India between September 2019 and August 2021. Children under 5 years were classified as group 1, and those aged 5 to 16 years were classified as group 2. Exclusion criteria included prior antibiotic use, growth of more than two microorganisms, fungal infections, prolonged hospital stay, and catheterized patients.

Urine samples were collected according to standard protocols and cultured. Bacterial growth was identified and subjected to sensitivity testing using the automated Vitek II compact system. Isolates were classified as ESBL bacteria if resistant to penicillins, first- to third-generation cephalosporins, and aztreonam (but not cephamycin or carbapenems). MDR isolates were resistant to two or more antibiotic groups.

Ethical clearance was obtained (reference number RAJH/SRC/DNB/0031), and data on clinical features, organism spectrum, antibiotic sensitivity, and ESBL/MDR occurrence were collected and analysed using Statistical tool SPSS V 25 (Armonk, NY).

RESULTS

Out of the 93 cases, 78 (83.9%) were in the age group of 1 month to <5 years, and 15 (16.1%) were in the 5 to 16 years group. Of the total cases, 53 (57%) were males, and 40 (43%) were females (Figure 1). Figure 2 shows the organism spectrum found in our study.

Clinical presentation

Fever was the most common symptom, present in 84 cases (90.3%). Dysuria occurred in 25 cases (26.88%). Increased frequency of micturition and symptoms of respiratory infection each were observed in 9 cases (9.6%). Gastrointestinal symptoms like vomiting or diarrhea were seen in 12 cases (12.9%). Bowel and bladder dysfunction symptoms included straining/dribbling (25.8%), constipation (22.5%), hesitancy (13.97%), and poor urinary stream (4.3%). Figure 3 shows the various clinical presntrations in the two age groups.

Gender-specific findings

Among males, phimosis was found in 65.2% of group 1 and 85.7% of group 2. Among females, labial adhesions were found in 6.3% of group 1 and none in group 2; this difference was not statistically significant (p=1.00).

Antenatal ultrasound findings

The 16 cases (17.3%) had an abnormal antenatal ultrasound (USG), whereas 77 (82.7%) had normal antenatal USG. USG during UTI was done in 88 cases; 45 (48.4%) showed normal results. Abnormal findings included mild renal pelvis prominence, APD >10 mm, thickened urinary bladder (>2 mm), pyelonephritis, and calcification.

Antimicrobial sensitivity and resistance

Table 1 shows the antibiotic susceptibility among the isolated organisms.

The prevalence of ESBL/MDR was 43.46% as seen in Figure 4. ESBL/MDR prevalence was similar in both age groups (46.2% in group 1 and 46.7% in group 2), with no statistically significant difference (p=0.971, chi-square=0.001).

Table 2 shows the age wise occurrence of *E. coli* and non *E. coli* organisms in group 1 and Table 3 shows the occurrence of *E. coli* and non *E. coli* in the age group 2.

These findings suggest that community-acquired pediatric UTIs are more prevalent in younger children, with *E. coli* being the predominant pathogen. Both age groups exhibited similar rates of multidrug resistance, underscoring the need for effective antimicrobial strategies.

Among 53 males in our study, 65.2% of boys in <5 years and 85.7% in ≥5 years had phimosis. Among 40 females in our study, only 6.3% girls in <5 years had labial adhesions. In >5 years age group, none had labial adhesions.

Among the total 93 cases studied, 16 (17.3%) of them had history of abnormal antenatal USG while 77(82.7%) of them normal antenatal USG. USG following UTI was done in 88 of the cases, of which 45 (48.4%) of them were normal. The most common abnormality in USG was noted to be mild prominence of renal pelvis APD in 19.4% of the cases. Other USG findings in our study were hydronephrosis and renal pelvis APD >10 mm (9.7%), hydronephrosis with bladder wall thickening (8.5%) and pyelonephritis (3.2%).

Among children with BBD, straining/dribbling was present in most of the cases (24.3% in <5 years vs 33.3% in ≥5 years), followed by constipation (20.5% in <5 years vs 40% in ≥5 years). Other symptoms noted were hesitancy and poor urinary stream. Thus, BBD was found more common in children more than 5 years.

In our study, MCU was done only for those whom abnormal ultrasound findings were seen. In <5 years age group, among the 43 children with abnormal USG, only 29 patients have done MCU, of which 16 were normal.

Among the abnormal MCU findings, most common finding was grade 2 VUR. In those ≥5 years, among 5 patients with abnormal USG, 3 of them did DMSA, of which 2 were abnormal.

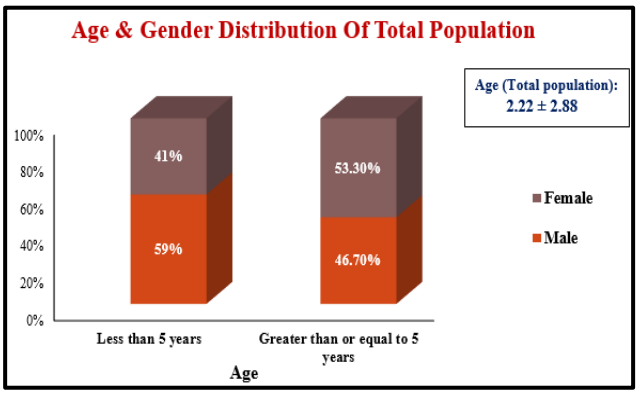

Figure 1: Demographic data.

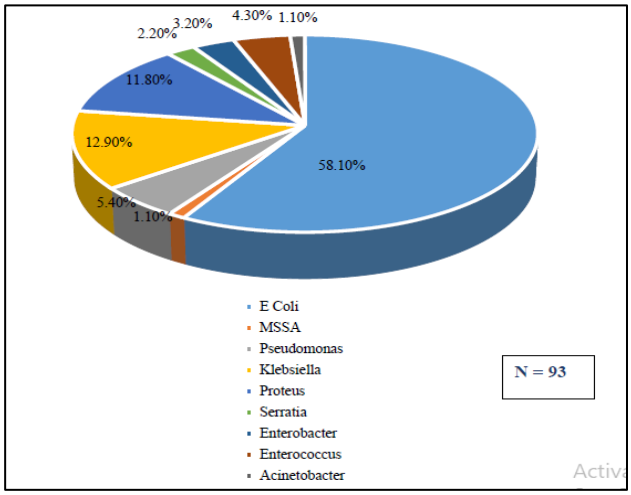

Figure 2: Organism spectrum in the study population, (n=93).

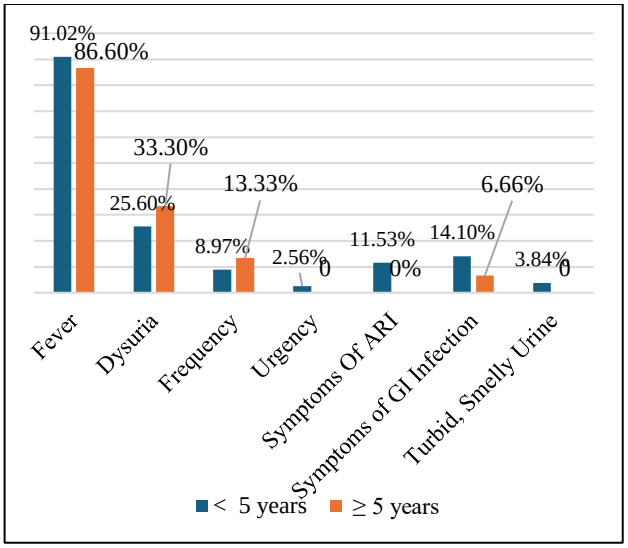

Figure 3: Clinical history at presentation in the two main age groups.

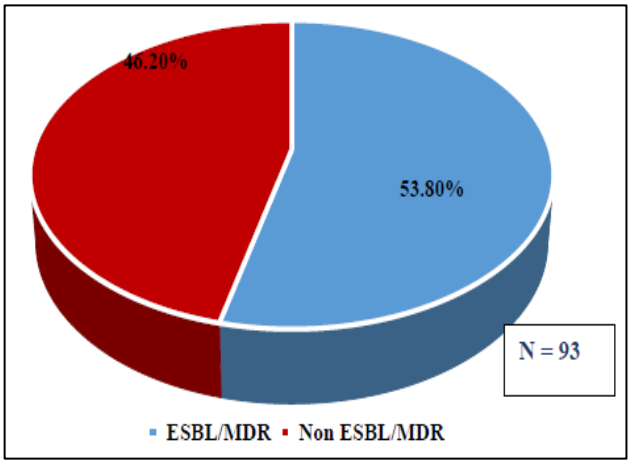

Figure 4: Proportion of ESBL/MDR among the total isolates (n=93).

Table 1: Antibiotic susceptibility patterns among the isolated organisms.

Antibiotics	Sensitive		Resistant	
	N	%	N	%
Amikacin	87	93.5	6	6.5
Amoxicillin	39	41.9	54	58.9
Amoxicillin-clavulanic acid	62	66.7	31	33.3
Ampicillin	41	44.1	52	55.9
Cefixime	44	47.3	49	52.7
Ceftriaxone	49	52.7	44	47.3
Ciprofloxacin	54	58.1	39	41.9
Meropenem	84	90.3	9	9.7
Gentamycin	74	79.6	19	20.4
Nitrofurantoin	69	74.2	24	25.8
Norfloxacin	67	72	26	28
Ofloxacin	68	73.1	25	26.9
Piperacillin-tazobactam	79	84.9	14	15.1
Cotrimoxazole	52	55.9	41	44.1
Cefoperazone-sulbactam	71	76.3	22	23.7

Table 2: Sensitivity pattern among *E. coli* and non *E. coli* organisms in group 1.

Antibiotics	*E. coli*/non *E. coli*	Sensitive/ resistant	P value
Amikacin	*E. coli*	43/3	1.00
	Non *E. coli*	27/2	
Gentamycin	*E. coli*	39/10	0.732
	Non *E. coli*	24/5	
Amoxycillin	*E. coli*	16/33	0.025
	Non *E. coli*	17/12	
Amoxyclav	*E. coli*	33/16	0.639
	Non *E. coli*	21/8	
Piperacillin tazobactum	*E. coli*	41/8	0.307
	Non *E. coli*	27/2	
Meropenam	*E. coli*	48/1	0.009
	Non *E. coli*	23/6	
Nitrofurantoin	*E. coli*	43/6	0.001
	Non *E. coli*	16/13	
Ofloxacin	*E. coli*	34/15	0.384
	Non *E. coli*	22/6	
Ciprofloxacin	*E. coli*	27/22	0.366
	Non *E. coli*	19/10	
Cefixime	*E. coli*	20/29	0.128
	Non *E. coli*	17/12	
Ceftriaxone	*E. coli*	23/26	0.112
	Non *E. coli*	19/10	
Cefoperazone sulbactum	*E. coli*	38/11	0.864
	Non *E. coli*	22/7	
Norfloxacin	*E. coli*	33/16	0.256
	Non *E. coli*	23/6	

Table 3: Sensitivity pattern among *E. coli* and non *E. coli* organisms in group 2.

Antibiotics	*E coli/non E coli*	Sensitive/resistant	P value
Amikacin	*E. coli*	4/1	0.333
	Non *E. coli*	10/0	
Gentamycin	*E. coli*	2/3	0.039
	Non *E. coli*	9/1	
Amoxycillin	*E. coli*	1/4	0.264
	Non *E. coli*	5/5	
Amoxyclav	*E. coli*	4/1	0.143
	Non *E. coli*	4/6	
Piperacillin tazobzctum	*E. coli*	5/0	0.231
	Non *E. coli*	6/4	
Ciprofloxacin	*E. coli*	2/3	0.464
	Non *E. coli*	6/4	
Norfloxacin	*E. coli*	3/2	0.409
	Non *E. coli*	8/2	
Ofloxacin	*E. coli*	3/2	0.409
	Non *E. coli*	8/2	
Meropenam	*E. coli*	5/0	0.524
	Non *E. coli*	8/2	
Nitrofurantoin	*E. coli*	4/1	0.439
	Non *E. coli*	6/4	
Cefixime	*E. coli*	1/4	0.143
	Non *E. coli*	6/4	
Ceftriaxone	*E. coli*	2/3	0.714
	Non *E. coli*	5/5	
Cefoperazone Sulbactum	*E. coli*	4/1	0.680
	Non *E. coli*	7/3	

DISCUSSION

Our study revealed a higher incidence of UTIs in males within the younger age group (59% in group 1), contrasting with other studies such as those by Jitendranath et al, Kawoosa et al and Patel et al where females predominated.[4,6,7] Fever was the most common symptom (90.3%), followed by dysuria (26.8%) and increased micturition frequency (9.6%). These findings align with those of Kawoosa et al and Patel et al although the exact prevalence rates vary.[6,7]

UTI co-infections with other sources, like respiratory or gastrointestinal infections, were noted in 9.6% and 12.9% of cases, respectively. This is consistent with studies by KN Shaw et al and Hoberman et al who reported UTI prevalence in febrile children with other infections.[8]

Symptoms specific to the lower urinary tract were more common in group 2 as noted by Ngyuen et al.[9] Bowel and bladder dysfunction (BBD) was also noted, with straining, dribbling, and constipation more prevalent in group 2, similar to findings by Tekgul et al and Shaikh et al.[10,11]

E. coli was the predominant organism (58.1%), similar to findings by Wu et al and Kawoosa et al and contrary to Abdullah et al in their study were more non *E. coli* organisms in < 5 years age group.[6,12,13] Non-*E. coli* organisms more common in the older age group. Antibiotic resistance patterns showed high resistance to amoxicillin and cefixime, while amikacin, meropenem, and piperacillin-tazobactam were highly effective. Gul et al reported similar sensitivity patterns.[14]

For group 1, the most sensitive antibiotics for *E. coli* were meropenem, amikacin, and piperacillin-tazobactam. Due to cephalosporin resistance and the WHO stewardship status of meropenem, amikacin or piperacillin-tazobactam are recommended.[15] For non-*E. coli* in group 1, high sensitivity was observed for amikacin, piperacillin-tazobactam, and meropenem. For group 2, similar antibiotic sensitivities were noted, supporting the use of piperacillin-tazobactam or amikacin for severe cases, and fluoroquinolones for non-*E. coli*.

The study also highlighted a significant prevalence of ESBL/MDR organisms (46.2%), underscoring the need for targeted antibiotic therapy. Similar findings were noted by Shreshta et al and Akram et al.[3,16]

Circumcision may reduce UTI incidence in boys, as suggested by Yang et al whereas labial adhesions were less common in girls in our study.[17] USG identified abnormalities in 48.4% of cases, with mild renal pelvis prominence being most common (19.4%), aligning with findings by Alshamsan et al.[18]

MCU (Micturating cystourethrogram) and DMSA (Dimercaptosuccinic acid) scans revealed abnormalities like VUR (Vesicoureteral reflux) and renal scarring, supporting similar trends observed by Gupta et al.[19] These findings emphasize the importance of thorough evaluation post-UTI to prevent long-term renal complications.

The strengths of our study include the estimation of ESBL/MDR incidence in community-acquired UTI cases and the comparison of clinical presentation and antibiotic sensitivity between two age groups. These findings help delineate the most appropriate antibiotics for different age groups and organism types. Future studies with larger sample sizes and comparisons of antenatal ultrasound with ultrasound during UTI are recommended to further refine treatment strategies.

CONCLUSION

Our study found that UTIs were more prevalent in children under 5 years of age. Fever was the most common presenting symptom in both age groups, with lower urinary tract symptoms like straining/dribbling, hesitancy, and frequency being more prevalent in the 5 to 16 years age group. Phimosis was observed in 67.9% of males, and labial adhesions in 5% of females. Symptoms of bowel and bladder dysfunction were present in 24.3% of children under 5 years and in 40% of those aged 5-16 years. *E. coli* was the predominant organism causing UTI.

The prevalence of ESBL and MDR bacteria was found to be 46.2% in community-acquired cases, highlighting the need for increased awareness among pediatricians. Among injectable antibiotics, amikacin showed the highest sensitivity and is recommended as the first-line treatment, followed by piperacillin-tazobactam. Common first-line oral antibiotics showed high resistance across all age groups, but amoxicillin-clavulanic acid, nitrofurantoin, and quinolones like norfloxacin or ofloxacin were effective alternatives.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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