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Clinical and Laboratory Profile of Paediatric UTI Cases at a Tertiary Care Hospital: A Cross-sectional Study

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ABSTRACT

Background: Urinary tract infections (UTIs) represent a significant health issue in children globally, with prevalence rates varying between 2% and 20%. If not diagnosed and managed promptly, these infections can result in severe consequences, including hypertension, chronic renal failure and renal scarring. This study assessed pediatric patients' clinical manifestations, diagnostic approaches, and prevalent bacterial pathogens associated with UTIs.

Methods: A cross-sectional study was conducted on 78 children with culture-confirmed UTIs. Clinical information was gathered using a semi-structured pro forma, and laboratory analyses were performed to determine the causative organisms and their antibiotic susceptibility profiles.

Results: In neonates, the most prevalent symptoms were fever, jaundice, and vomiting. In older children, fever, dysuria, and lethargy were the most common symptoms. Escherichia coli emerged as the predominant pathogen, followed by *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*. Piperacillin-tazobactam exhibited high sensitivity, and amikacin showed about 90% sensitivity rate.

Conclusion: Accurate and timely diagnosis of pediatric UTIs, based on distinct clinical signs and laboratory evaluations, is essential for preventing severe outcomes. Identifying prevalent pathogens and their antibiotic sensitivities is critical for formulating effective treatment protocols.

Key-words: Urinary Tract Infection; *Escherichia coli;* Antibiotic Susceptibility; Fever; Children

INTRODUCTION

Urinary tract infections represent a major public health issue within the pediatric population and are among the most frequently encountered bacterial infections in children. The incidence of UTIs in children ranges from 2% to 20%, with approximately 8% of girls & 2% of boys have had at least one episode by the age of seven [1-4].

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These infections can significantly affect morbidity, potentially resulting in severe long-term consequences such as renal scarring, hypertension, and chronic renal failure, particularly in cases with vesicoureteral reflux. This highlights the critical need for timely and precise diagnosis [5-7].

Diagnosing UTIs in young children is challenging due to the non-specific nature of symptoms [8]. For instance, infants commonly present with fever, which can also result from other conditions like otitis media or viral infections. As the condition advances, typical UTI symptoms such as frequent urination, urgency, dysuria, or suprapubic discomfort may be either minimal or gradually developing in toddlers and young children. The

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lack of age-specific symptom recognition increases the risk of delayed diagnosis and treatment. Additionally, an understanding of bacterial resistance to antibiotics is inadequate. The high prevalence of resistant uropathogens and insufficient awareness of this resistance, coupled with prevailing prescribing practices, contribute significantly to the high incidence of UTIs [9].

The fragmented understanding of the disease and antibiotic resistance results in gaps in treatment across different age groups and among healthcare providers. This study addresses these gaps by investigating clinical symptoms, prevalent bacterial pathogens, and their resistance patterns. It aims to meet several practical goals to enhance diagnostic and treatment approaches and reduce long-term morbidity. While the clinical presentation of pediatric UTIs is crucial for early diagnosis, limited research is available on this topic. Addressing this gap could illuminate issues specific to different age groups and improve clinical practice. The study aimed to elucidate typical clinical presentations and effective treatment strategies for pediatric UTIs to enhance patient outcomes and minimize the risk of long-term complications.

MATERIALS AND METHODS

This investigation was structured as a cross-sectional study to examine children aged 0–18 years, who exhibited symptoms of UTIs and were admitted with culture-positive urine samples.

Sampling Technique and Sample Size- A convenience sampling approach was employed to select patients who met the inclusion criteria. Based on a 23% prevalence rate of culture-positive UTIs and a 10% absolute error, the sample size calculation indicated that 69 culture-positive cases were required. Finally, 78 participants were enrolled.

Inclusion Criteria- Pediatric patients aged 0–18 years with any symptom of UTI and a positive urine culture.

Exclusion Criteria- Children, who had received antibiotics before urine culture; samples that yielded multiple microorganisms. Fungal growths isolated from urine cultures; the presence of antenatally detected structural anomalies, such as urinary tract malformation, posterior urethral valve, vesicourethral reflux, and congenital hydronephrosis.

Study Procedure- Data was collected using a semi-structured pro forma, with written informed consent obtained from parents or guardians. Collected data included the participant's name, age, sex, and socioeconomic status. Clinical data encompassed presenting symptoms, past medical history, and findings from physical examinations. Routine laboratory investigations included a complete blood count, serum creatinine, and serum urea, which are essential for assessing the patient's overall health and renal function. For urine sample collection, procedures differ based on the age and developmental stage of the child. In infants and young children, urine samples were collected aseptically using catheterization or suprapubic aspiration to ensure a sterile specimen.

In contrast, midstream clean-catch samples were employed for older, toilet-trained children. These urine samples were promptly forwarded for routine examination, including culture and sensitivity testing. In the context of urine analysis, the presence of pus cells is considered significant if more than 5 cells per high power field (HPF) are observed. This threshold helps in diagnosing potential infections or other urinary abnormalities. Urine cultures were performed using standard microbiological methods. Biochemical tests were employed for pathogen identification. Antimicrobial susceptibility was evaluated using the Kirby–Bauer disk diffusion method. Tested antibiotics included Amikacin, Cefepime, Ceftriaxone, Cefuroxime, Cephalexin, Ceftazidime, Ciprofloxacin, Cotrimoxazole, Gentamicin, Nitrofurantoin, Norfloxacin, and Piperacillin-tazobactam.

Statistical Analysis- Data were entered into Microsoft Excel and analyzed using SPSS V21. Descriptive statistics summarized demographic and clinical data. The Chi-square test evaluated associations between categorical variables, with a significance threshold set at $p<0.05$.

RESULTS

The study included 78 pediatric participants, with a higher representation of females (n=53, 67.95%) than males (n=25, 32.05%). The age distribution was varied, with the largest proportion of participants aged between 1-3 years (n=24, 30.77%), followed by those aged 1-12 months (n=21, 26.92%) (Table 1).

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Table 1: Age and Gender of study participants

Age Group	Males		Females		Total	
	n	%	n	%	n	%
0–28 days	3	3.85	6	7.69	9	11.54
1–12 months	7	8.97	14	17.95	21	26.92
1–3 years	7	8.97	17	21.79	24	30.77
3–6 years	4	5.13	12	15.38	16	20.51
6–18 years	4	5.13	4	5.13	8	10.26
Total	25	32.05	53	67.95	78	100

The clinical symptoms exhibited varied significantly with age. Unexplained fever was the most prevalent symptom across all age groups, affecting 97.44% (n=76) of the participants. Pain or burning during micturition was also highly reported, especially in the older age groups, with an overall prevalence of 76.92% (n=60). Diarrhoea and vomiting were more common in younger children, with prevalence rates of 43.59% (n=34) and 44.87% (n=35) respectively. Jaundice was exclusively observed in neonates (0-28 days), affecting all nine participants in this age group. Poor weight gain was reported by 17.95% (n=14) of the participants, with the highest incidence in infants aged 1-12 months and neonates (Table 2).

Table 2: Age distribution of clinical presentation in study participants

Symptom	0–28 days (n=9)	1–12 months (n=21)	1–3 years (n=24)	3–6 years (n=16)	6–18 years (n=8)	Total (n=78)
Diarrhea	6 (66.67)	10 (47.62)	12 (50)	6 (37.5)	0 (0)	34 (43.59)
Jaundice	9 (100)	0 (0)	0 (0)	0 (0)	0 (0)	9 (11.54)
Lethargy	3 (33.33)	13 (61.9)	10 (41.67)	12 (75)	4 (50)	42 (53.85)
Pain/ burning micturition	4 (44.44)	17 (80.95)	17 (70.83)	14 (87.5)	8 (100)	60 (76.92)
Poor weight gain	3 (33.33)	7 (33.33)	1 (4.17)	3 (18.75)	0 (0)	14 (17.95)
Unexplained fever	9 (100)	20 (95.24)	23 (95.83)	16 (100)	8 (100)	76 (97.44)
Vomiting	7 (77.78)	6 (28.57)	13 (54.17)	9 (56.25)	0 (0)	35 (44.87)

Laboratory results indicated significant abnormalities in the majority of the study participants. A high percentage of children (94.87%, n=74) exhibited elevated pus cells in urine (>5/HPF), indicative of UTIs. Total leukocyte count was abnormal in 66.67% (n=52) of the participants. Conversely, most participants' hemoglobin levels were within normal range (83.33%, n=65). Imaging studies via ultrasound of the kidney, ureter, and bladder (USG-KUB) were normal in 98.72% (n=77) of cases, and all participants had normal platelet counts, serum creatinine, and serum urea levels (Table 3).

Table 3: Laboratory Findings in Pediatric UTIs cases

Parameter	Normal		Abnormal	
	n	%	n	%
Pus cells in urine (>5/HPF)	4	5.13	74	94.87
Total leukocyte count	26	33.33	52	66.67
Hemoglobin	65	83.33	13	16.67
USG-KUB	77	98.72	1	1.28
Platelet count	78	100	0	0
S. creatinine	78	100	0	0
S. urea	78	100	0	0

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Table 4 shows the distribution of uropathogens varied by age group. Escherichia coli was the most common pathogen, identified in 44.44% (n=37) of cases, particularly prevalent in children aged 3-6 (81.25%, n=13). *K. pneumoniae* was the second most frequent pathogen, accounting for 30.77% (n=24) of infections, with the highest incidence in neonates (44.44%, n=4). *P. aeruginosa* was present in 6.41% (n=5) of cases, predominantly in older children (6-18 years). Other pathogens included *Enterococcus faecalis* (5.13%, n=4), *Proteus mirabilis* (3.85%, n=3), and Acinetobacter species (1.28%, n=1), with varied distribution across different age groups.

Table 4: Age wise frequency of uropathogens in Pediatric UTIs cases

Urinary Pathogen	0–28 days (n=9)	1–12 months (n=21)	1–3 years (n=24)	3–6 years (n=16)	6–18 years (n=8)	Total (n=78)
Escherichia coli	1 (11.11)	10 (47.62)	10 (41.67)	13 (81.25)	3 (37.5)	37 (44.44)
Klebsiella pneumoniae	4 (44.44)	7 (33.33)	9 (37.5)	1 (6.25)	3 (37.5)	24 (77.77)
Pseudomonas aeruginosa	0 (0)	1 (4.76)	1 (4.17)	0 (0)	3 (37.5)	5 (41.41)
Enterococcus faecalis	0 (0)	3 (14.29)	1 (4.17)	0 (0)	0 (0)	4 (13.13)
Proteus mirabilis	1 (11.11)	0 (0)	1 (4.17)	1 (6.25)	0 (0)	3 (85.85)
Acinetobacter species	1 (11.11)	0 (0)	0 (0)	0 (0)	0 (0)	1 (28.28)

The antibiotic sensitivity analysis of pediatric UTI cases, as depicted in Fig. 1, reveals substantial variability in the efficacy of different antibiotics. Piperacillin-tazobactam exhibited the highest sensitivity, with all tested isolates (100%) susceptible. This suggests that piperacillin-tazobactam is a highly effective option for treating pediatric UTIs in the study population. Amikacin also demonstrated a strong performance, with a sensitivity rate of 90%, indicating its substantial efficacy in combating uropathogens. Norfloxacin and gentamicin were effective in 88% and 87% of cases, respectively. These antibiotics show promise but are slightly less effective than piperacillin-tazobactam and amikacin. Ciprofloxacin, however, had the lowest sensitivity rate among the tested antibiotics, with only 70% of the isolates being susceptible. This lower efficacy suggests that ciprofloxacin may not be the most reliable first-line treatment for pediatric UTIs in the studied cohort.

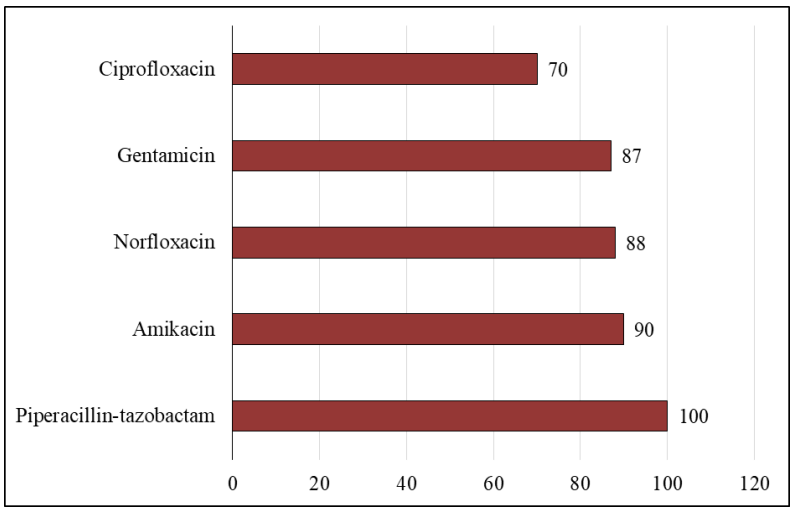

Fig. 1: Antibiotic sensitivity among Pediatric UTIs cases

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DISCUSSION

This study offers an in-depth analysis of clinical presentations, prevalent bacterial pathogens, and antimicrobial susceptibility patterns in UTIs among 78 children admitted to a tertiary care Indian hospital. The results indicate that *E. coli* was the most commonly identified uropathogen, followed by *K. pneumoniae* and *P. aeruginosa.* Notably, there was high sensitivity to piperacillin-tazobactam and amikacin, whereas there was substantial resistance to cephalexin and cefepime.

These findings corroborate the established dominance of *E. coli* as a uropathogen, consistent with research by Shaikh *et al.* which reported that *E. coli* was responsible for 75–90% of pediatric UTIs [10]. The high susceptibility to amikacin is in line with Thapa *et al.* research, which found 89% of *E. coli* isolates were susceptible [11]. However, regional variations in resistance patterns were observed. For instance, Hayer et al. reported lower cephalosporin resistance in North America [12-14]. Such discrepancies may arise from differences in prescribing practices and surveillance efficacy. Therefore, regional monitoring of antimicrobial resistance patterns is essential for guiding empirical treatment.

This study highlights several crucial findings regarding UTIs caused by *E. coli. E. coli* remains the predominant pathogen in pediatric UTIs, with significant implications for antimicrobial sensitivity and resistance patterns [15]. The effectiveness of piperacillin-tazobactam and amikacin suggests their suitability for empirical treatment [16]. However, the alarmingly high cephalosporin resistance rates underscore the need for more conservative antibiotic policies and tailored antimicrobial resistance profiling in local contexts.

The study's strength lies in its well-defined cohort and standardized microbiological methods for reliable UTI confirmation. Nevertheless, the sample size may be insufficient for broader generalizations, and the study's cross-sectional nature limits causal inferences about incidence rates, susceptibility patterns, or long-term outcomes related to antibiotic resistance. Additionally, the exclusion of patients with prior antibiotic treatment could lead to an underestimation of resistance rates.

CONCLUSIONS

The findings of this study emphasize the importance of continuous monitoring and updating clinical practice guidelines to address infections that contribute to significant morbidity in pediatric populations and lead to severe health outcomes. Future research should include multicenter studies with larger sample sizes and extended durations to validate these results and refine clinical guidelines. It is particularly important to study patients with prior antibiotic exposure to reflect community resistance patterns accurately. Additionally, evaluating the impact of antibiotic stewardship programs and the genetic factors influencing susceptibility could inform the development of personalized treatment strategies.

The effectiveness of various treatments, social and economic factors, and the quality and accuracy of rapid diagnostic methods should also be examined PPV.

CONTRIBUTION OF AUTHORS

Research concept- Uditkumar Agrawal, K. K. Pandey
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