

Urinary Tract Infection Profile in Pediatric Patients: A Clinicobacteriological and Radiological Analysis

¹Naresh Chandra Acharya, ²Swayamprabha Sahoo, ²Sweta Padma Routray, ²Jatindra Nath Mohanty*

¹Department of Paediatrics, IMS and Sum hospital, SOA deemed to be University, Bhubaneswar-751003, Odisha, India

²Medical Research Laboratory, IMS and Sum hospital, SOA deemed to be University, Bhubaneswar-751003, Odisha, India

Corresponding Author

Dr. Jatindra Nath Mohanty, Assistant Professor, Medical Research Laboratory, IMS and Sum hospital, SOA deemed to be University, Bhubaneswar-751003, Odisha, India

Mail id-jatindranathmohanty@soa.ac.in

Abstract

This cross-sectional study was conducted at a tertiary center in Odisha, Eastern India, to identify the profile of urinary tract infections in children (UTI), pathogenic bacteria, and monitoring of vesicoureteral reflux (VUR) and scarring of renal dysfunction in these patients. The study involved a total of 524 pediatric patients aged ≤ 13 years who were suspected of having urinary tract infections. Urine samples were collected to isolate uropathogens and antibiotic susceptibility testing was carried out according to guidelines from the Institute for Clinical and Laboratory Standards (CLSI). 32 children with detected UTI cultures underwent microtouringcysto-urethrography (MCU) and dimercaptosuccinic acid (DMSA) for 69 children. Of the 524 children, 186 (35.4%) had a proven BMI culture because 105 (56.4%) were infants, 50 (27.4%) were between the ages of 1 and 5 years, 30 (16.12%) were between 5 -13 years and 129 (69.35%) male. Posterior urethral valve (PUV) was found in three patients, hydronephrosis in 18, VUR in 18 and renal scarring in 33. In men > 1 year, both VUR and renal scarring were more common. There was a significant association ($P = 0.0054$) with the combined sensitivity and specificity of this study, 83% and 90%, respectively, of the MCU and DMSA scans for VUR detection. Escherichia coli is the most common isolated pathogen sensitive to nitrofurantoin, followed by cefoperazonesulbactam, aminoglycosides, and meropenem. Our results suggest that urinary tract infections vary according to age and sex and a full evaluation is required in boys under one year of age with urinary tract infections. This study also highlighted the better in vitro efficacy of aminoglycosides, cefoperazonesulbactam and nitrofurantoin compared to meropenem on Gram-negative uropathogens.

Keywords: cefoperazonesulbactam, children, meropenem, posterior urethral valve (PUV), urinary tract infection (UTI), vesicoureteral reflux

Introduction

In children, urinary tract infection (UTI) most often manifests as fever of unknown origin. The clinical features of urinary tract infections in infants and young children can range from hidden and undiagnosed fever to gastrointestinal manifestations and upper and lower urinary tract symptoms, whereas urinary tract symptoms may be observed in older children¹. The frequency of urinary tract infections depends on the age of the child. Five percent of children under the age of two who have a fever have an IMP. In the first year of life, especially in the first three months, IMP was more common in boys (3.7%) than in girls (2%). UTIs were later reported to occur in 3 percent of girls and 1.1 percent of boys [1]. Children are at risk for urinary tract infections due to certain anatomical and physiological factors, the most common of which is vesicoureteral reflux (VUR). VUR causes recurrent infections and other complications such as chronic pyelonephritis and possibly renal scarring, which is a component of reflux nephropathy. Therefore, it is important to diagnose this condition in a timely manner as it is a preventable cause of kidney damage[2].

Bacteria are a common cause of urinary tract infections in children, with *Escherichia coli* being the most common isolated pathogen. The susceptibility pattern of bacterial isolates varies according to geographic area and serves as a guide for empirical therapy. The causes of urinary tract infections in childhood and the susceptibility of antibiotics to urinary tract pathogens both in the community and in hospitals are changing, and drug resistance is a major problem [3,4,5,6]. With this in mind, this study was undertaken to monitor the profile of pediatric IMP, to identify the bacterial pathogens involved and their antimicrobial susceptibility, and to provide a brief overview of VUR and sequential renal scarring in these patients in our tertiary center.

Material and methods

This cross-sectional study was conducted at the Department of Microbiology in collaboration with the Department of Pediatrics and Medical research laboratory at IMS and Sum hospital. Patients: All consecutive pediatric patients (children \leq 13 years of age) suspected of having a urinary tract infection were included after obtaining written consent from their legal guardian. We also collect important information about patient demographics, previous incidence of UTI, family history of UTI / VUR, drug use, previous interventions, and other illnesses.

Microbiological and Radiological Methods: Urine samples taken from patients were processed according to standard microbiological procedures with a 1 microliter chain calibrated using the semi-quantitative method of applying cysteine lactose deficiency electrolytes (Hi-Media, Mumbai, India). Isolate uropathogens. Antibiotic susceptibility testing was carried out according to the Kirby-Bauer method⁷ according to the Institute for Clinical Laboratory Standards (CLSI) [8,9,10]. At the same time, follow-up data for cysto-urethrography (MCU) and dimercaptosuccinic acid (DMSA) scan reports from these patients were collected.

Statistical Analysis: All data were expressed as percentages, Yates' corrected hydraulic test was used to analyze the data, and odd ratios were calculated using Wolff's correction.

Result and discussion

Of the 524 children with suspected IMP who were included in this study, 186 (35.4%) had a positive culture. The most common type (85%) is simple IPA (an uncomplicated community acquired by IPA). Of the 186 children with detectable UTI cultures, 32 had MCU scans, of which 18 (56.25%) had VUR (6 bilateral and 12 unilateral). Kidney scar tissue was found in 33 (47.8%) of the 69 children who underwent a DMSA scan. There was a significant association ($P = 0.0054$) with the combined sensitivity and specificity of this study, 83 and 90% of MCU and DMSA scans for VUR detection. Of the culture-proven BMI cases ($n = 186$) 114 (61.2%) children admitted to the pediatric ward (OPD), 32 (17.2%) were admitted to the pediatric ward, 25 (13.44%) required surgical management and 15 (8%) required intensive care.

The maximum number of episodes of IMP in children \leq one year (Table I). The majority of the participating children were boys (129, 69.4%) (Table 1). VUR and renal scarring are more common in men than in women (data not shown in Table I). Therefore, a complete assessment is required for boys over one year of Natural Science. Our observations are consistent with previous reports [11].

Table 1: All demographic and culture details

Risk factors for urinary tract infection (UTI)				
Variables	UTI (culture positive n=93) N (%)	UTI (culture negative n=169) N (%)	Odds ratio (95% CI)	P value
age \leq 1 yr	53(56.5)	73(42. 9)	1.725 [1.202-2.476]	P=0.0040
age >1 yr	40(43.5)	96(57.1)		
VUR	9(9.7)	2(1.2)	3.787 [1.252-11.456]	P=0.02
No VUR	84(88.2)	167(98.8)		
Males	65(69.4)	108(63.9)	1.301 [0.888-1.903]	P=0.20
females	28(30.6)	61(36.1)		
males in infancy	33(35.5)	41(24.3)	1.278 [0.871-1.874]	0.24
females in infancy	20(20.9)	22(13. 1)		
No co-morbidites	78(83.3)	154(91.4)	0.469 [0.272-0.806]	0.0083
with co-morbidities	15(83.3)	15(8.6)		
VUR, vesicoureteric reflux				

The most important uropathogen isolated was *Escherichia coli*, followed by *Enterococcus faecalis* and *Klebsiella pneumoniae* (Table I). The majority of *E. coli* and *Klebsiella* isolates were sensitive to nitrofurantoin, followed by cefoperazonesulbactam, aminoglycosides and meropenem. Our results differ from previous studies from North India⁴ but similar to others [12-15]. The susceptibility patterns of the most frequently isolated pathogens indicated that OPD-derived isolates were more susceptible to most antibiotics than those in the compartment, followed by Pediatric intensive cases (PICU). Both *E. coli* and *K. pneumoniae* were sensitive to nitrofurantoin, amikacin, cefoperazonesulbactam, followed by meropenem. *Enterococcus faecalis* is the most common isolated pathogen among gram-positive organisms. Vancomycin-resistant enterococci were isolated from seven children admitted to the ICU, three of whom had posterior urethral valve (PUV), one with catheter-induced urinary tract infection, one underwent PUV surgery, while the other two children did not. There are risk factors that must be identified. 33.3% of staphylococci were MRSA (methicillin resistant *Staphylococcus aureus*). Most children with VUR-associated UTIs had a significant bacteriuria of more than 100,000 CFU / ml, similar to previous reports.

Conclusion

In conclusion, our study shows that UTI varies according to age and sex and therefore requires a comprehensive assessment of boys under one year of age with UTI. This study also highlighted the better in vitro efficacy of aminoglycosides, cefoperazonesulbactam and nitrofurantoin compared to meropenem on Gram-negative uropathogens. Long-term studies on large samples of children should be planned to better understand disease processes in terms of interactions between host and microbial factors.

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