Microbiological Analysis and Antibiotic Sensitivity Pattern of Urinary Tract Infection in Children, A Retrospective Study

**Abstract:** Children are prone to urinary tract infections especially those under the age of 2 years. Urinary tract infections pose a great threat if there is any delay in diagnosis and treatment, leading on to various complications including renal scarring, hypertension, impaired renal function and even end-stage renal disease. Hence it is necessary to identify the organisms responsible and the antibiotics useful in treatment of these conditions. The study population included infants and children less than 14 years of age with symptoms of UTI and who have undergone urine culture and sensitivity. All identified isolates were tested for susceptibility against various antibiotics using Kirby Bauer disc diffusion technique on Mueller-Hinton agar. All study variables were analysed using descriptive statistical methods like frequencies and percentages for categorical variables and mean with standard deviation for continuous variables. Most of the children belonged to <=1 year age group. Majority of the cultures showed positivity for E. coli (63%), followed by Klebsiella (19%) and enterococcus species (7%). Cephalosporins showed higher resistance (61.5 – 87.2%) against E. coli. Piperacillin – Tazobactam (7.7%), Amikacin (10.3%) and Nitrofurantoin (12.8%) had least resistance to E.coli. Enterococcus species showed resistance to majority of the antibiotics. The extensive use of antibiotics in urinary tract infections without the help of culture and sensitivity reports has resulted in emergence of resistance to commonly used antibiotics. One should take utmost care in prescribing antibiotics, especially in cases of UTI or else we will be forced to use injectable antibiotics for treating even uncomplicated UTI.

**Keywords:** Antibiotic, Children, Resistance, Sensitivity, Susceptibility, Urinary tract infection.

**INTRODUCTION**

One of the most common infectious diseases diagnosed in outpatients as well as among young children less than 2 years are urinary tract infection (UTI)(Barišić et al., 2003)(Shaikh N et al., 2008)(Dromigny J et al., 2002). The signs and symptoms of UTI differ between adults and children. Older children and adults present with increased frequency, urgency, dysuria, flank, and supra-pubic pain, while toddlers or young children may just present with fever(Winberg et al., 1974)(Ginsburg et al., 1982). Urinary tract infections pose a great threat if there is any delay in diagnosis and treatment, leading on to various complications including renal scarring, hypertension, impaired renal function and even end-stage renal disease(Haller M et al., 2004)(Beattie TJ et al., 1994). UTI occur more commonly in women, mainly due to the anatomical differences, hormonal effects, and behaviours(Minardi D et al., 2011). Colonic bacteria such as Escherichia coli, Klebsiella and Proteus account for almost 75-90% of all urinary tract infection(Shaikh et al., 2008). On top of that, the antibiotic resistance is also increasing in uropathogenic bacteria(Garin et al., 2006)(Conway et al., 2007)(Craig et al., 2009). Various risk factors that can lead to resistance in narrow spectrum antibiotics include recurrent infections, hospitalization, bowel and bladder dysfunction, recent antibiotic exposure, and increased prophylaxis therapy with antibiotics in children(Shaikh et al., 2016)(Bryce et al., 2016)(Topaloglu et al., 2010)(Dayan et al., 2013).

There is a scarcity of data on antibiotic sensitivity and resistance among uropathogenic bacteria in Indian setting. Hence this study was conducted to identify the organisms responsible for UTI in children and sensitivity and resistance of various antibiotics available in Indian sub-continent.
**Methodology**

A cross sectional study was conducted among the children presented to the paediatric outpatient department during a one-year period. The study population included infants and children less than 14 years of age with symptoms of UTI and who have undergone urine culture and sensitivity. The symptoms included fever with dysuria and/or cloudy or foul-smelling urine and/or loss of bladder control and/or lower back pain. All the urine cultures were examined at the microbiology laboratory in Travancore Medical College, Kerala. Insignificant cultures (the growth of more than one bacterium, the growth of lower than standard quantity of colony forming units/ml [CFU], and the growth of bacteria considered contaminants) were excluded from the study.

Urine samples were collected using urinary catheterization, sterile foil bowl placed underneath the genitalia, or a plastic bag attached to the genitalia for children under the age of 3 years and clean catch specimen by midstream method in toilet trained children. Any child who was receiving any kinds of antimicrobial treatment during urine collection was excluded from the study. Cystine lactose electrolyte deficient (CLED) agar (HiMedia Pvt. Ltd., India) and blood agar (HiMedia Pvt. Ltd., India) were used for streaking urine samples for semi-quantitative method using calibrated loop. Urine culture was considered positive when there was a growth of >10^3 CFU/ml in a sample obtained by transurethral catheterization or the growth of >10^5 CFU/ml in a clean catch midstream urine sample (Vandepitte et al., 2003).

All identified isolates were tested for susceptibility against amikacin, cefixime, imipenem, nitrofurantoin, piperacillin-tazobactam, cephalexin, gentamicin, trimethoprim/sulfamethoxazole and ceftriaxone using Kirby Bauer disc diffusion technique on Mueller-Hinton agar (HiMedia Pvt. Ltd., India). Clinical and Laboratory Standards Institute (CLSI) criteria was used for interpretation of susceptibility tests.

The data was collected in Microsoft Excel and analysed using IBM SPSS version 26. All study variables were analysed using descriptive statistical methods like frequencies and percentages for categorical variables and mean with standard deviation for continuous variables.

**Results**

The study was conducted among 62 children less than 14 years of age, with lowest age being one month and oldest child being 13 years of age. Majority of the children belonged to the <=1 age group. It was interesting to note that majority were males in the age group of <=1 as well as 10 – 14 years age group (Table 1).

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Male (%)</th>
<th>Female (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;=1</td>
<td>16 (53.3)</td>
<td>14 (46.7)</td>
<td>30</td>
</tr>
<tr>
<td>2 - 5</td>
<td>11 (42.3)</td>
<td>15 (57.7)</td>
<td>26</td>
</tr>
<tr>
<td>6 – 9</td>
<td>0 (0.0)</td>
<td>3 (100.0)</td>
<td>3</td>
</tr>
<tr>
<td>10 - 14</td>
<td>2 (66.7)</td>
<td>1 (33.3)</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>29 (46.8)</td>
<td>33 (53.2)</td>
<td>62</td>
</tr>
</tbody>
</table>

In this study, majority of the cultures showed positivity for *E. coli* (63%), followed by *Klebsiella* (19%) and *enterococcus species* (7%) (Fig 1).
In this study we checked the susceptibility and resistance of different antibiotics towards various organisms responsible for UTI in the study population. Enterococcus species responsible for UTI in 4 study subjects showed resistance to majority of the antibiotics used in the study. Only Nitrofurantoin and Gentamicin showed promising levels of susceptibility towards enterococcus. But in case of UTI because of Klebsiella, both Nitrofurantoin and Cephalexin showed resistance in around 75% of cases. Nitrofurantoin was not showing any action against proteus as well as pseudomonas infections and showed only protective effect in one third cases due to Acinetobacter (Table 2).

Table 2: Antibiotic Resistance Patterns of Isolated Uropathogens

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>E.coli (%)</th>
<th>Klebsiella (%)</th>
<th>Enterococcus sp (%)</th>
<th>Proteus (%)</th>
<th>Pseudomonas (%)</th>
<th>Acinetobacter (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amikacin</td>
<td>4 (10.3)</td>
<td>1 (8.3)</td>
<td>4 (100.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>1 (33.3)</td>
</tr>
<tr>
<td>Cefixime</td>
<td>25 (64.1)</td>
<td>4 (33.3)</td>
<td>4 (100.0)</td>
<td>0 (0.0)</td>
<td>1 (50.0)</td>
<td>3 (100.0)</td>
</tr>
<tr>
<td>Imipenem</td>
<td>11 (28.2)</td>
<td>5 (41.7)</td>
<td>4 (100.0)</td>
<td>1 (50.0)</td>
<td>2 (100.0)</td>
<td>2 (66.7)</td>
</tr>
<tr>
<td>Nitrofurantoin</td>
<td>5 (12.8)</td>
<td>9 (75.0)</td>
<td>2 (50.0)</td>
<td>2 (100.0)</td>
<td>2 (100.0)</td>
<td>2 (66.7)</td>
</tr>
<tr>
<td>Piperacillin – tazobactam</td>
<td>3 (7.7)</td>
<td>1 (8.3)</td>
<td>4 (100.0)</td>
<td>1 (50.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Cephalexin</td>
<td>34 (87.2)</td>
<td>9 (75.0)</td>
<td>4 (100.0)</td>
<td>1 (50.0)</td>
<td>2 (100.0)</td>
<td>3 (100.0)</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>9 (23.1)</td>
<td>1 (8.3)</td>
<td>1 (25.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>2 (66.7)</td>
</tr>
<tr>
<td>Trimethoprim - Sulamethoxazole</td>
<td>20 (51.3)</td>
<td>2 (16.7)</td>
<td>4 (100.0)</td>
<td>0 (0.0)</td>
<td>2 (100.0)</td>
<td>1 (33.3)</td>
</tr>
<tr>
<td>Ceftriazone</td>
<td>24 (61.5)</td>
<td>4 (33.3)</td>
<td>4 (100.0)</td>
<td>0 (0.0)</td>
<td>2 (100.0)</td>
<td>3 (100.0)</td>
</tr>
</tbody>
</table>

Considering the most common organism causing UTI, i.e., E.coli, resistance was least with Piperacillin – Tazobactam (7.7%), followed by Amikacin (10.3%) and Nitrofurantoin (12.8%). It was interesting to note that cephalosporins were least effective against E. coli as Cephalexin (87.2%), Cefixime (64.1%) and Ceftriazone (61.5%) showed higher resistance in this study.
DISCUSSION

Majority of the urinary tract infections occur as a result of ascent of bacteria from the perineum into the urinary tract. In addition to this, UTI can also occur through hematogenous route. When kidneys are infected with these bacteria, the outcome is acute pyelonephritis (Mishra OP et al., 2013). The recurrence and complications of UTI has warranted the need for various studies on UTI. Antibiotic resistance is a dreadful outcome of the inadvertent use of antibiotics in treating UTI. Hence it is important to find the resistance pattern of various bacteria causing UTI.

Around 1.7% of boys and 8.4% of girls below the age of 7 years are affected with UTI (Hellström A et al., 1991). In our study the incidence of UTI was almost similar in both males and females. But males were more affected among infants and those between the age group of 10 – 14 years. Various other studies show higher rate of UTI among female children (White B, 2011).

In this study conducted among 62 children, the most common organism responsible for UTI was E.coli (63%) which was similar to many other studies conducted around the globe (Kashef N et al., 2010) (Azizi A et al., 2014) (Ganesh R et al., 2019). The second most common organism responsible for UTI in children in our study was Klebsiella (19%). Ganesh et al., also reported Klebsiella spp., to be the second prominent organism responsible for UTI (Ganesh R et al., 2019).

The antibiotic resistance pattern of E.coli in this study showed an interesting finding. Piperacillin – Tazobactam, amikacin and nitrofurantoin showed the least resistance while cephalosporins showed higher resistance to the organism. Nitrofurantoin can be taken in outpatient basis while piperacillin – tazobactam and amikacin requires hospital admission and hence it’s use is limited to inpatients only. The unscrupulous use of cephalosporins in various bacterial infections might have resulted in the emergence of resistance to these drugs. The study conducted by Pouladfar G et al., also showed increased resistance to the cephalosporins. They attributed the cause for resistance to the production of extended spectrum beta lactamase by both E.coli as well as Klebsiella (Pouladfar et al., 2017).

The resistance of other organisms in this study is also a major concern. Majority of the uncommon pathogens responsible for UTI has showed resistance to most of the drugs used in this study. If this pattern is continued, it might be difficult to treat UTI due to uncommon pathogens in the near future. Enterococci
reported sensitivity only to gentamicin and nitrofurantoin. Enterococci is considered as one of the major causes of healthcare acquired UTI (Pouladfar et al., 2017).

The extensive use of antibiotics in UTI without looking at the culture and sensitivity report has resulted in emergence of resistance. We need to take utmost care in prescribing antibiotics, especially in cases of UTI or else soon we will be forced to use injectable antibiotics for even uncomplicated UTI.

REFERENCES


