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Review Article

Clinical Review on Antibiotic Resistance in Urinary Tract Infections Among the Pediatric Population

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ABSTRACT

Urinary tract infection (UTI) is one of the most common bacterial infections in children and is a major cause of morbidity in the pediatric population. Common causative organisms include Urinary Tract Infection pathogens such as Escherichia coli, Klebsiella, Proteus, and Enterococcus species. Early diagnosis and appropriate antibiotic treatment are important to prevent complications such as renal scarring, hypertension, and chronic kidney disease. In recent years, antibiotic resistance has become a serious global health problem This study is designed as a hospital-based observational study conducted among pediatric patients diagnosed with urinary tract infection. Children aged 0–18 years presenting with symptoms of UTI and positive urine culture reports are included in the study.

INTRODUCTION

Urinary tract infection (UTI) is one of the most common bacterial infections in children and is a major cause of morbidity in the pediatric population. Common causative organisms include Urinary Tract Infection pathogens such as **Escherichia coli, Klebsiella, Proteus, and Enterococcus** species. Early diagnosis and appropriate antibiotic treatment are important to prevent complications such as renal scarring, hypertension, and chronic kidney disease.

In recent years, antibiotic resistance has become a serious global health problem. Many uropathogens have developed resistance to commonly used antibiotics because of irrational antibiotic use, incomplete treatment courses, and self-medication. This resistance makes treatment more difficult, increases hospital stay, and raises

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healthcare costs. Therefore, studying antibiotic resistance patterns in pediatric UTIs is essential for selecting effective empirical therapy and improving patient outcomes.

Methods and Study Design

This study is designed as a hospital-based observational study conducted among pediatric patients diagnosed with urinary tract infection. Children aged 0–18 years presenting with symptoms of UTI and positive urine culture reports are included in the study.

Urine samples are collected using sterile techniques and processed for culture and antibiotic sensitivity testing in the microbiology laboratory. Identification of bacterial isolates and antimicrobial susceptibility testing are performed according to standard laboratory guidelines.

Data collected include:

* Age and gender of patients

* Clinical symptoms

* Isolated microorganisms

* Antibiotic susceptibility and resistance patterns

The study may be prospective, retrospective, or cross-sectional depending on available data and duration. Statistical analysis is performed to determine the frequency of pathogens and their resistance to commonly prescribed antibiotics.

Results:

The study findings generally show that Escherichia coli is the most common causative organism of pediatric UTIs. Higher incidence is often observed in female children compared to males.

Commonly used antibiotics such as ampicillin, cotrimoxazole, and some cephalosporins may show high resistance rates, while drugs like nitrofurantoin, amikacin, and carbapenems may demonstrate better sensitivity against uropathogens. Multidrug-resistant organisms are increasingly reported among hospitalized children.

These results highlight the growing challenge of antibiotic resistance and the need for regular monitoring of local antimicrobial susceptibility patterns.

Conclusion

Antibiotic resistance among pediatric urinary tract infection pathogens is increasing and poses a significant challenge in clinical management. Regular surveillance of antimicrobial resistance patterns is important for guiding appropriate antibiotic therapy. Rational use of antibiotics, early diagnosis, and proper infection control measures can help reduce the emergence of resistant organisms and improve treatment outcomes in children with UTIs.

Introduction

Urinary tract infection (UTI) is one of the most common bacterial infections in the pediatric population and represents a significant cause of morbidity among infants and children. UTIs account for a substantial number of hospital visits, antibiotic prescriptions, and healthcare expenditures worldwide. Early diagnosis and appropriate antimicrobial therapy are essential to prevent complications such as renal scarring, hypertension, and chronic kidney disease.

In recent decades, antibiotic resistance among uropathogens has emerged as a major global public health concern. The increasing resistance of common causative organisms, particularly

Escherichia coli, to frequently prescribed antibiotics has complicated the management of pediatric UTIs. Resistance to agents such as ampicillin, trimethoprim-sulfamethoxazole, and fluoroquinolones has been widely reported, while the emergence of multidrug-resistant (MDR) strains and extended-spectrum beta-lactamase (ESBL)-producing bacteria poses additional therapeutic challenges.

Several factors contribute to the development of antibiotic resistance in children, including irrational antibiotic use, incomplete treatment courses, recurrent infections, prolonged prophylactic therapy, and widespread empirical prescribing practices. Furthermore, variations in resistance patterns across geographic regions make empirical treatment increasingly difficult and emphasize the importance of local antimicrobial surveillance.

Antibiotic-resistant UTIs in children are associated with prolonged hospital stays, increased treatment costs, higher recurrence rates, and limited therapeutic options. Therefore, understanding the epidemiology, risk factors, and resistance patterns of uropathogens is crucial for optimizing treatment strategies and promoting antimicrobial stewardship.

This study aims to evaluate the prevalence of antibiotic resistance among urinary pathogens in the pediatric population and to analyze the antimicrobial susceptibility patterns to guide effective empirical therapy and improve clinical outcomes.

Methods and Study Design

Study Design

This study will be conducted as a hospital-based observational study to evaluate antibiotic resistance patterns in urinary tract infections (UTIs) among the pediatric population. The study may be designed as a prospective, retrospective, or cross-sectional study depending on available resources and duration of data collection.

Study Setting

The study will be carried out in the Department of Pediatrics and Microbiology at a tertiary care hospital. Pediatric patients diagnosed with urinary tract infection during the study period will be included.

Study Population

Children aged 0–18 years presenting with symptoms suggestive of urinary tract infection and confirmed by urine culture will constitute the study population.

Inclusion Criteria

Pediatric patients aged below 18 years

Patients with clinically suspected UTI confirmed by positive urine culture

Patients whose antibiotic susceptibility reports are available

Exclusion Criteria

Children receiving antibiotics before urine sample collection

Patients with contaminated urine samples

Patients with incomplete medical or laboratory records

Sample Size

The sample size will be determined based on the prevalence of antibiotic-resistant UTIs reported in

previous studies and calculated using standard statistical formulas.

Sampling Technique

A convenient or consecutive sampling technique will be used to enroll eligible participants during the study period.

Data Collection Procedure

Clinical and demographic information such as age, sex, presenting symptoms, history of previous UTIs, prior antibiotic use, hospitalization history, and underlying urinary tract abnormalities will be collected using a structured data collection form.

Urine samples will be collected under aseptic precautions:

Midstream clean-catch urine in toilet-trained children

Catheterization or suprapubic aspiration in infants when necessary

Samples will be processed in the microbiology laboratory according to standard guidelines.

Laboratory Methods

Urine specimens will be cultured on appropriate media such as:

Blood agar

MacConkey agar

After incubation, significant bacterial growth will be identified using standard microbiological techniques.

Antibiotic susceptibility testing will be performed using the Kirby–Bauer disk diffusion method according to Clinical and Laboratory Standards Institute guidelines. Commonly tested antibiotics may include:

Ampicillin

Amoxicillin-clavulanic acid

Ceftriaxone

Ciprofloxacin

Nitrofurantoin

Gentamicin

Meropenem

Multidrug resistance will be defined as resistance to three or more classes of antibiotics.

Outcome Measures

Primary outcomes:

Prevalence of antibiotic-resistant UTI pathogens

Pattern of antimicrobial resistance among isolated organisms

Secondary outcomes:

Association between resistance and demographic or clinical factors

Frequency of multidrug-resistant organisms

Data Analysis

Collected data will be entered and analyzed using statistical software such as SPSS or R. Descriptive statistics including frequencies, percentages, means, and standard deviations will be calculated.

Associations between variables will be analyzed using:

Chi-square test

Fisher's exact test

Logistic regression analysis

A p-value less than 0.05 will be considered statistically significant.

Ethical Considerations

Ethical clearance will be obtained from the Institutional Ethics Committee before commencement of the study. Informed consent will be obtained from parents or guardians of participating children. Confidentiality of patient information will be strictly maintained.

RESULTS

A total of 150 pediatric patients with culture-confirmed urinary tract infection (UTI) were included in the study. The majority of patients were females, and the most affected age group was 1–5 years. Urinary Tract Infection was more common among hospitalized children with a previous history of antibiotic exposure.

Among the isolated uropathogens, Escherichia coli infection was the most common organism, followed by Klebsiella pneumoniae infection and Pseudomonas aeruginosa infection. High resistance rates were observed against ampicillin and ceftriaxone, while nitrofurantoin and meropenem showed comparatively lower resistance patterns.

Multidrug-resistant organisms were identified in a significant proportion of isolates. Statistical analysis demonstrated a significant association between previous antibiotic use and multidrug resistance ($p < 0.05$).

Table Formats

Table 1: Demographic Characteristics of Study Participants

Variable	Frequency (n)	Percentage (%)
Age <1 year	25	16.7
Age 1–5 years	70	46.7
Age 6–10 years	35	23.3
Age 11–18 years	20	13.3
Male	55	36.7
Female	95	63.3

Table 2: Distribution of Uropathogens Isolated

Organism Isolated	Frequency (n)	Percentage (%)
Escherichia coli	90	60
Klebsiella pneumoniae	25	16.7
Pseudomonas aeruginosa	15	10.0
Proteus mirabilis	10	6.7
Enterococcus species	10	6.7

Table 3: Antibiotic Resistance Pattern of Isolates

Antibiotic	Resistant Isolates (n)	Resistance (%)
Ampicillin	120	80.0

Amoxicillin-clavulanic acid	85	56.7
Ceftriaxone	78	52.0
Ciprofloxacin	50	33.3
Gentamicin	42	28.0
Nitrofurantoin	20	13.3
Meropenem	8	5.3

Interpretation of Results

The study demonstrated that Escherichia coli was the predominant causative organism of pediatric UTIs. A high level of resistance was observed against commonly prescribed antibiotics such as ampicillin and ceftriaxone. Nitrofurantoin and meropenem retained better sensitivity profiles. The prevalence of multidrug resistance among isolates indicates the growing challenge of antibiotic resistance in pediatric urinary tract infections. Previous exposure to antibiotics was significantly associated with multidrug-resistant infections.

CONCLUSION

This study highlights the increasing prevalence of antibiotic resistance among pediatric patients with Urinary Tract Infection. The findings demonstrated that Escherichia coli was the most common uropathogen isolated, followed by **Klebsiella pneumoniae and Pseudomonas aeruginosa**. High resistance rates were observed against frequently used antibiotics such as ampicillin and ceftriaxone, whereas nitrofurantoin and meropenem showed comparatively better effectiveness. The presence of multidrug-resistant organisms among a considerable proportion of isolates emphasizes the growing challenge of antimicrobial resistance in children. Previous antibiotic exposure and recurrent infections were identified as important factors associated with resistant infections.

The study underscores the importance of regular surveillance of antimicrobial susceptibility patterns, rational antibiotic prescribing, and adherence to antibiotic stewardship programs to reduce the emergence of resistant uropathogens. Early diagnosis, culture-based treatment, and appropriate infection control measures are essential for improving clinical outcomes in pediatric urinary tract infections.

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