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Research Article

Bacterial Profile and Antibiotic Susceptibility Patterns of Urinary Tract Infection Among Children in Karbala Teaching Hospital

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ABSTRACT

Urinary tract infections (UTIs) are common diseases in pediatric age groups. The emergence of bacterial strains that exhibit resistance to specific antimicrobial agents has led to several therapeutic challenges. This study aimed to evaluate the frequency and antimicrobial susceptibility patterns of common types of bacteria isolated from urine samples of patients with urinary tract infections in Karbala Teaching Hospital for Children. The study was conducted between September 2021 and January 2022. The susceptibilities of antimicrobial agents were determined using the Kirby-Bauer disk diffusion technique. Positive cultures from 56 patients were included in the analysis. *Escherichia coli* and *Proteus* spp. were the most common organisms identified in pediatric patients suspected of a UTI (50% *and* 14.3%, respectively), while *Raoutella ornithimolytics* and *Enterobacter* sp. represented 7.14%. Other bacteria like *Pseudomonas aeruginosa*, *Staphylococcus saprophyticus*, *Acinetobacter baumannii*, *Serratia* spp., and *Kluyvera* spp. represented 3.6%. The sensitivity of *E. coli* isolates to imipenem, amikacin, and chloramphenicol were 92.9%, 85.7%, and 78.6%, respectively. *Proteus* spp. isolates solely exhibited susceptibility to amikacin and nalidixic acid. The current study concluded that *E. coli* was the most frequently arising underlying pathogen UTI in pediatric patients. In this clinical setting, the organisms identified exhibited high susceptibility to imipenem, amikacin, and chloramphenicol.

Keywords: Antimicrobial susceptibility, Children, Karbala Hospital, Urinary Tract Infection

Introduction

Urinary tract infection is one of the most common infections caused by bacteria in children. Infections of the urinary tract also comprise the most frequently arising hospital-acquired infections, being responsible for as many as 35% of nosocomial events. They are the second leading source of bacteremia in pediatric patients. The principal bacteria that give rise to UTIs are Gram-negative organisms (e.g., *E. coli* and *K. pneumonia);* Gram-positive bacteria, such as *S. saprophyticus* and *E. faecalis*, may also be responsible [1]. The clinical outcomes of UTI are highly variable and reliant on several covariates, such as gender, age, the genetic susceptibility of the host, the disease-inducing pathogen, the response to antimicrobial agents, local trends of resistance to antibiotics and the quality of care provided [2]. In children and neonates, the clinical manifestations of UTI may lack specificity [3,4]. Thus, an accurate diagnosis should be facilitated by the prompt analysis, culture, and investigation of urine samples for causative organisms and their sensitivity to antimicrobial agents. Due to the advent of broad-spectrum antibiotics, there is a rising incidence of organisms exhibiting

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multi-drug resistance (MDR) in pediatric clinical institutions, a situation that is causing consternation [5]. MDR potentially hinders successful therapy for UTIs [6]. The frequency of organisms identified as demonstrating MDR is increasing globally and in Iraq [7,8]. To reduce the mortality rate and morbidity arising from UTIs, such as renal abscesses, sepsis, and subsequent renal impairment from fibrosis, it is essential to swiftly recognize the presence of UTIs and institute antibiotic treatment [9]. An acute UTI is typically managed according to the patient's symptomatology and urinalysis without confirmation from microbiological investigations [10,11]. The current study aims to establish the rate of sensitivity to antimicrobial agents in uropathogenic bacteria isolated from pediatric patients presenting with UTIs at the Karbala Teaching Hospital for Children and determine the regional trends in the administration of antibiotics for UTI treatment.

Material and Methods

Sample collection

This cross-sectional retrospective study was conducted at the Karbala Teaching Hospital for Children between September 2021 and January 2022. The urine samples were collected from 56 patients aged under 12 years. Inclusion criteria were the presence of symptoms and signs of a UTIs. Children who had received antimicrobial agents were excluded from the study. Verbal consent was acquired from the children's guardians. The study was approved by the University of Karbala College of Medicine Ethical Committee (Ref. no. 30); the Karbala Health Directorate and Karbala Teaching Hospital for Children also gave their consent for the study. A standardized questionnaire was used to facilitate data collection. Midstream urine specimens were acquired from patients with a suspected UTI and transported to the microbiology laboratory in sterile containers.

Sample preparation and analysis

Aerobic cultures of the urine samples were established on MacConkey cysteine-lactose-electrolyte deficient agar. Samples were incubated for 24-48 hours at a temperature of 37 °C. If the plated colony count achieved 10^5 cfu/ml, this was assumed to indicate bacteriuria [12]. Subsequently, subcultures were performed on blood agar and MacConkey agar. The profiles of identified bacteria were delineated using Gram staining and biochemical tests. Catalase, novobiocin disk and coagulase investigations were used for Gram-positive organisms. Indole, methyl red, Voges-Proskauer, and citrate tests, triple sugar iron, urease, oxidase, and lysine decarboxylase agar tests were carried out for Gram-negative bacteria. The technique recommended by the Clinical Laboratory Standards Institute version 2021 for establishing susceptibility to antimicrobial agents is Kirby-Bauer disk diffusion on Muller Hinton agar [13].

Results and Discussion

Although bacterial pathogens responsible for UTIs include Gram-negative and Gram-positive organisms, Gram-negative bacteria are the most prevalent, with the vast majority being caused by infection with *E. coli* [14,15]. The current research has established the prevalence of UTI in the study participants, together with the identified causative agents and their pattern of antibiotic susceptibility. The sociodemographic parameters of the 56 children recruited into the study are displayed in Table 1.

Of the 56 patients, 30 (54%) were males and 26 (46%) were females. Their ages ranged from 1 day to 12 years; the mean age was 2.87 years. The cohort was subdivided into three age groups: < 1 year (46.42%); 1-6 years (35.71%); and 6-12 years (17.85%). The higher proportion of male patients presenting with suspected UTIs in the current study population. In a study conducted in Ethiopia [16] found the percentage of infected males was (21%) and females (79%), which disagrees with our study, where UTIs were more frequent in males than in females. The females participants appeared to have a lower vulnerability to UTI, a discrepancy that may have arisen from diversity within the ages of the subjects, the population size

Table 1. Sociodemographic characteristics of the studied sample.

Sociodemographic characteristics	Frequency	%
Gender		
Male	30	54
Female	26	46
Total	56	100
Age		
<1 yrs	26	46.42
1-6 yrs	20	35.71
6-12 yrs	10	17.85
Total	56	100

and the frequency of complications. In this study, the highest prevalence of UTI (46 %) was noted in those children aged under 1 year. This is consistent with two studies performed in Iraq [17] and Greece [18], in which the age groups with the highest frequency of UTI were less than 1 year (27.72%). The propensity for this age-group to acquire UTI may be related to underlying urinary tract anomalies, an impaired immune response or alternative concomitant conditions.

Table 2. Bacterial profile of culture from urine of patients with UTIs.

Bacterial profile	Number	%
E. coli	28	50
Proteus spp.	8	14.3
R. ornithimolytics	4	7.14
Enterobacter spp.	4	7.14
P. aeruginosa	2	3.6
K. pneumonia	2	3.6
S. saprophyticus	2	3.6
A. baumannii	2	3.6
Serratia spp.	2	3.6
Kluyvera spp.	2	3.6
Total	56	100

Table 2 illustrates the types of pathogens cultured from the urine samples. *E. coli* (n=28, 50%) and *Proteus* spp. (n=8, 14.3%) were the most common organisms recognized. There were four (7.15%) cases each *of Raoultella ornithimolytics* and *Enterobacter* were identified; two (3.6%) instances each of *P. aeruginosa, S. saprophyticus, A. baumannii, Serratia* and *Kluyvera* spp. were also recorded. In the study population, *E. coli* represented 50% of the total organism isolates. (Table 2).

These results concur with a study conducted in 2021 in Tehran, which identified *E. coli* as the most frequent etiological agent underlying UTI in children (77.6%) [19]. Other studies from additional nations have confirmed this finding [20-21]. Studies conducted in Saudi Arabia, South Korea, India, Turkey, and Bangladesh reported that the prevalence of *E. coli* was 50%-80% [22]. Alanazi and his colleges (2018) in Saudi Arabia reported that 51.72% of *E. coli* that found in children that enrolled with our study [23]. *E. coli* is the most frequently arising organism within the intestine; therefore, it can encroach into the urinary tract. Its virulence and ability to colonize the latter is well-recognized.

In keeping with the results obtained in this study Erol *et al*. observed that *Proteus* spp. was the second most common causative organism of

Table 3. Antibiotic sensitivity (S) and resistance (R) of bacteria infecting patients with a suspected UTI.

Type of pathogenic bacteria	Sensitivity	Gentamycin	Cefixime	Amikacin	Nalidixic acid	Ceftriaxone	Imipenem	Tetracycline	Chloramphenicol	Augmentin
E. coli	S	6 (21%)	12(42.9%)	24(85.7%)	4 (14.3%)	4(14.3%)	26(92.9%)	14(50%)	22(78.6%)	14(50%)
	R	22(79%)	16(57.1%)	4(14.3%)	24(85.7%)	24(85.7%)	2 (7.1%)	14(50%)	6(21.4%)	14(50%)
***Proteus* spp.**	S	2 (25%)	2(25%)	8(100%)	8(100%)	6 (75%)	6(75%)	4(50%)	4(50%)	4(50%)
	R	6 (75%)	6(75%)	-	-	2 (25%)	2(25%)	4(50%)	4(50%)	4(50%)
R. ornithinolytica	S	2(50%)	-	4(100%)	2(50%)	-	4(100%)	-	4 (100%)	-
	R	2(50%)	4(100%)	-	2(50%)	4(100%)	-	4(100%)	-	4(100%)
***Enterobacter* spp.**	S	2 (50%)	-	4 (100%)	2(50%)	-	4 (100%)	-	4 (100%)	-
	R	2 (50%)	4 (100%)	-	2 (50%)	4 (100%)	-	4(100%)	-	4 (100%)
P. aeruginosa	S	2 (50%)	-	2 (100%)	-	-	2(100%)	2(100%)	2(100%)	-
	R	-	2 (100%)	-	2 (100%)	2 (100%)	-	-	-	2 (100%)
K. pneumonia	S	2(100%)	-	2(100%)	2(100%)	2(100%)	2(100%)	2(100%)	2(100%)	2(100%)
	R	-	2 (100%)	-	-	-	-	-	-	-
S. saprophyticus	S	-	-	2(100%)	-	-	-	2(100%)	2(100%)	-
	R	2(100%)	2 (100%)	-	2 (100%)	2 (100%)	2 (100%)	2(100%)	2 (100%)	-

UTI in pediatric patients [24]. Only a low (3.6%) incidence of *P. aeruginosa, K. pneumonia, A. baumannii, Serratia and Kluyvera* spp. was identified. This is consistent with the findings in India [25] who reported a lower frequency of *A. baumannii* and *P. aeruginosa* in samples from patients with suspected UTI. Only 3.6% of isolates were Gram-positive (*S. saprophyticus*) in the current study population. This bacterium is the most frequently recognized Gram-positive pathogen underlying UTI in children.

There are regional variations in the resistance to antimicrobial agents seen both in Iraq and globally; this may be attributed to the genetic traits of resistance within strains, discrepancies in antibiotic prescriptions and diversity in access to pharmaceutical supplies. Bacterial antimicrobial resistance can be genetically acquired as innate and inherited cellular factors can lead to suppression of the mechanisms of action of antimicrobial agents [26]. The relative fraction changes according to locality. The greatest susceptibility was seen in *E. coli* for imipenem (n=26, 92.9%), amikacin (n=24, 85.7%), and chloramphenicol (n=22, 78.6%). *Proteus* spp. exhibited sensitivity to both amikacin (n=8, 100%) and imipenem (n=8, 100%) (Table 3). The results from the current study in Table 3 demonstrate that there was a high susceptibility of Gram-negative organisms to imipenem, amikacin and chloramphenicol (i.e. 95.2%, 85% and 75%, respectively). Two previous studies, from France in 2017 [27] and from Greece in 2020 [28] determined that amikacin was the optimal antibiotic for treating UTIs in children and infants; those results concur with the sensitivities identified in this study. However, in contrast, a 2021 study from Tehran, Iran reported the high degree of resistance of Gram-negative organisms to amikacin, ceftriaxone, and imipenem [29]. A study conducted in Pakistan also described organisms that were extremely resistant to a range of antimicrobial agents like cefixime, ceftriaxone, ciprofloxacin, and nalidixic acid [30].

Conclusion

It can be surmised from the data that the majority of UTIs were related to infection with Gram-negative bacilli. The most frequently observed resistance in bacterial isolates in pediatric patients with suspected UTIs was toward cefixime and ceftriaxone. The greatest susceptibility was seen in relation to imipenem and amikacin. The most prevalent identified pathogen in this population of children with UTI during the timeframe of the study was *E. coli.*

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