——————————Original Articles

Antibiotic Susceptibility of Uropathogens Causing Urinary Tract Infection in Central Teaching Hospital of Pediatrics

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ABSTRACT

Background: Bacterial resistance has regarded as one of the major public health concerns. Urinary tract infections with antibiotic resistant bacteria have become more common in bacterial infections with very limited antibiotic options.
Objectives: To focus the light on antibiotic susceptibility and resistance of bacterial strains responsible for urinary tract infection in children.
Methods: A prospective, observational study carried out on 573 febrile patients between 1 month and 18 years of age, on emergency room visit base in Central Teaching Hospital of pediatrics in Baghdad, Iraq from January to June 2017. Urine culture and bacterial susceptibility investigated by appropriate culture media and antibiotic discs.
Results: The study revealed culture proven urinary tract infection in 116 (20.24%) of febrile children. E coli accounted for 73 (54.9%) of cases followed by Klebsiella pneumonia that was responsible for 17(12.8%) of cases. Most of the isolated bacteria that implicated as a cause of urinary tract infection showed a good sensitivity to imipenem, amikacin, nitrofurantoin, and gentamicin. Moreover, bacterial resistance to antibiotics found to be a major problem especially for penicillin and cephalosporin, which were the less susceptible.
Conclusion: Because of a relatively high rate of bacterial resistance to different antibiotics, this study suggests nitrofurantoin as the best oral antibiotic treatment and aminoglycosides or imipenem as the preferred parenteral therapy for urinary tract infection in children.
Keywords: Urinary tract infection, Urine culture and sensitivity, Antibiotic therapy.

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Urinary tract infection is a significant health problem that commonly affects children[1]. It is estimated to be the third most common cause of fever in children after gastrointestinal infections and respiratory diseases[2].

Overall, the prevalence of UTI among children is approximately 4-7%. However, it varies according to the age, sex, race, nutritional state, and the state of circumcision[3]. The common uropathogens include E coli, Proteus mirabilis, Klebsiella pneumoniae, enterobacter, Pseudomonas aerugenousa, and enterococcus. However, E coli is responsible for 70% of urinary tract infections[4].

Additionally, Proteus species are common cause of UTI in uncircumcised males, whereas the causative pathogen in adolescent females is staphylococcus saprophyticus[5].

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The clinical presentation of urinary tract infection depends on age and site of infection (upper or lower). Thus, it is variable from asymptomatic bacteriuria to severe complicated UTI[6].

In children with suspected UTI, a positive urinalysis (dipstick) and/or urine microscopy must not be relied on and a urine culture and sensitivity should be sent. However, commencement of empiric antibiotics must be started until availability of urine culture result (>24 hours)[7].

Antibiotic resistance is the reduction in effectiveness of a drug in curing a disease. When an organism is resistant to more than one drug, it is said to be a multidrug-resistant[8].

Bacterial strains possess different resistance mechanisms such as antibiotic inactivation (β-lactam antibiotics), group

transfer (macrolides), and gene mutation (fluoroquinolones)[9-11].

This study aimed to define the causative bacterial species of UTI and antibiotic susceptibility and resistance in febrile infants, children, and adolescents.

Methods

This is an observational prospective study that enrolled a total of 573 pediatric patients aged 1 month to 18 years who had been feverish or develop fever (axillary temperature > 37.5 ^{o}C) in Central Teaching Hospital of Pediatrics emergency room over a period of six months from 1st of January until 30th of June 2017. Exclusion criteria include patients received antibiotics during current illness and/or patients with known urological disease such as vesico-ureteric reflux. Clean catch mid-stream urine samples had been collected, then cultured on a blood agar with 5% sheep blood and MacConkey agar and incubated at 37^{o}C for 18-24 hours. Bacterial identification performed via using standard conventional methods including API 20 E, API 20 Staph, and Gram stain[12]. The antibiotic sensitivity test done on Mueller-Hinton agar via disc diffusion test by using Kirby-Bauer's method and sensitivity and resistance were determined measuring the diameter of zones around each antibiotic according to clinical laboratory standard institute guidelines.

Data analysis done by using statistical package of social science (version23).

Results

In this study, urine culture found to be positive in 116(20.24%) urine specimens with higher incidence in females 73(27.7%) in comparable to 43(13.9%) in males. Culture proven UTI was more frequent below 1 year of age 25(30.8%).

Distribution of microorganisms isolated by urine culture include Escherichia coli 73(54.9%), Klebsiella pneumoniae 17(12.8%), Enterococcus species 16(12%), Proteus mirabilis 12(9%), Pseudomonas aerugenousa 11(8.3%), Staphylococcus aureus 3(2.25%), and Citrobacter 1(0.75%).

Almost all of isolated bacterial strains found to be sensitive to imipenem, amikacin, gentamicin, and nitrofurantoin. Klebsiella pneumoniae has shown the highest resistance pattern in which all Klebsiella isolates (100%) were resistant to ampicillin and cephalothin. However, most E. coli isolates were resistant to ampicillin (91.7%), amoxicillin-clavulanic acid (86.3%), cephalothin (86.3%) and sulfamethoxazole-trimethoprim (82.1%), (Table 1).

Table 1: Number and percentage of isolated uropathogens with antibiotic resistance.

Antibiotic	*E. Coli*	*Klebsiella pneumonia*	*Enterococcus*	*Proteus mirabilis*	*Pseudomonas aeruginosa*	*Staph. aureus*
Ampicillin	67 (91.7)	17 (100)	13 (81.25)	11 (91.6)	10 (90.9)	3 (100)
Amoxicillin/ Clavulanic acid	63 (86.3)	15 (88.2)	12 (75)	10 (83.3)	9 (81.8)	2 (66.6)
Cephalothin	63 (86.3)	17 (100)	9 (56.25)	8 (66.6)	10 (90.9)	1 (33.3)
Cefoxitin	58 (79.4)	12 (70.5)	11 (68.75)	7 (58.3)	10 (90.9)	3 (100)
Ceftriaxone	54 (73.9)	11 (64.7)	13 (81.25)	6 (50)	8 (72.7)	2 (66.6)
Cefixime	51 (69.8)	13 (76.4)	12 (75)	9 (75)	11 (100)	2 (66.6)
Cefepime	28 (38.4)	9 (52.9)	7 (43.75)	5 (41.6)	7 (63.6)	1 (33.3)
SXT	60 (82.1)	16 (94.1)	13 (81.25)	10 (83.3)	6 (54.5)	2 (66)
Ciprofloxacin	16 (21.9)	2 (11.7)	4 (25)	2 (16.6)	1 (9)	0 (0)
Nitrofurantoin	8 (10.9)	3 (17.6)	2 (12.5)	2 (16.6)	9 (81.8)	0 (0)
Gentamicin	3 (4.1)	3 (17.6)	1 (6.25)	3 (25)	6 (54.5)	1 (33.3)
Amikacin	3 (4.1)	3 (17.6)	2 (12.5)	3 (25)	0 (0)	0 (0)
Imipenem	0 (0)	0 (0)	1 (6.25)	0 (0)	3 (27.2)	0 (0)

Discussion

In this study, culture proven UTI was diagnosed in 116(20.24%) of febrile patients that had been admitted to emergency room in central teaching hospital of pediatrics. Nearly similar percentage obtained in a study conducted in Kars, Turkey (18.5%)[13]. However, this is lower than the percentage obtained in similar study in Erbil, Iraq (43.3%)[14]. This difference could be attributed to differences in population and risk factors.

In studies that had performed throughout the world, including our study, E. coli was the most common cause of UTI because of multiple virulence factors such as adhesions, toxins, iron acquisition, and lipopolysaccharide capsules[15,16].

Klebsiella pneumoniae was the second common cause of UTI (12.8%) in accordance with studies in Sanliurfa, Turkey[17] and Aberytwyth, UK[18]. However, Staphylococcus aureus ranked secondly as a cause of UTI in Erbil study[14]. This difference could be related to differences in risk factors such as age, comorbid conditions, and if the infection is, hospital or community acquired.

Enterococcus species account for 16(12%) in this study comparable to 4% and 2.8% in Erbil and Sanliurfa studies respectively[14,17]. However, in Bagshaw et al study, Enterococcus was the third most frequent cause of UTI in intensive care unit[19]. This could be related to emergency room base study where 15% of nosocomial UTI attributes to Enterococcus[20]. The resistance pattern of E. coli was nearly similar to other national and abroad studies[14, 21-23]. As shown in table 2, most of E. coli strains have been resistant to ampicillin, cephalothin, and to a lesser extent to ciprofloxacin. Additionally, most of E. coli strains were sensitive to amikacin, nitrofurantoin and nearly all isolates were sensitive to imipenem. It is worth to mention, our study and Erbil one had shown a high resistant E. coli to sulfamethoxazole-trimethoprim as compared to other studies[14]. It might be the result of widespread use of it in UTI treatment in Iraq.

Apart from this, 100% of Klebsiella strains were resistant to ampicillin and cephalothin and almost all resistant to sulfamethoxazole-trimethoprim. This result was compatible with an Indian study that revealed an increasing rate of Klebsiella antibiotic resistance[24].

In conclusion, this study revealed the extent of uro-pathgenic bacterial isolates resistance to certain commonly used antibiotics such as penicillin and cephalosporin and sulfamethoxazole-trimethoprim. On other hand, most of the implicated microorganisms as a cause of UTI have demonstrated a good response to imipenem, amikacin, gentamicin, and nitrofurantoin. As a result, it is advisable for pediatricians to be aware of the magnitude of antimicrobial resistance and to rely on urine culture and sensitivity result in the treatment of urinary tract infection. Moreover, an effective antibiotic policy and guidelines should be introduced. Furthermore, regular antimicrobial susceptibility surveillance is essential for endemic resistance pattern monitoring.

Table 2: Antibiotic resistance pattern of E. coli in different studies.

Author	Chiman H et al[14]	Niranjan V et al[21]	Hadadi M et al[22]	Al-Mijalli SHS[23]	Current study
Country	Iraq	India	Iran	KSA	Iraq
Year	2009-2010	2014	2016	2015	2017
Ampicillin	95.8	88.4	84.4	98.9	91.7
Ceftriaxone	75	71.4	-	98.89	73.9
Ciprofloxacin	20.8	75	33.3	62.64	21.9
SXT	87.5	64.2	55.2	29.67	82.1
Nitrofurantoin	14.6	17.9	29.2	10.99	10.9
Amikacin	6.3	17.4	49	1.1	4.1
Imipenem	-	1.1	-	1.1	0

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