Research Article

Antibiotic Resistance in Children with Urinary Tract Infection at Al-Mahmodyiah General Hospital: Descriptive Study

Sa`ad H. Mohammed[1] and Ruaa Allawy Hasan[2]

[1]Department of Pediatrics, Al-Mahmodyiah hospital, Baghdad, Iraq (Remove Italics)
[2]Al-Karach Health Directorate, Baghdad, Iraq

Abstract

Background: The urinary tract infection (UTI) is common in children under 15 years especially in females more than 1 year, that may lead many morbidities such as chronic infection, weight loss and renal failure. The aim of this study is therefor to assess the causative microorganism of UTI and to evaluate the empirical antibiotic treatment of UTI by culturing the causative organism and antibiotic resistance patterns of urine examination for children visits the outpatient clinic in Al-Mahmodyiah hospital.

Methods: A total of 638 children with positive urine culture were included in the study. Antibiotic susceptibility testing was performed with Vitek 2 Compact for 10 commonly used antimicrobials.

Results: Age ranged from 0 - 15 years, divided into 4 main groups. *Escherichia coli* 376 (59%), were the most common pathogens. For all isolated microorganisms, a high level of resistance was found against cefepim, ampicillin, and trimethoprim/sulfamethoxazole. A high sensitivity was noted for meropenem, nitrofurantoin, gentamicin and amikacin.

Conclusions: Antibiotic resistance in pediatric UTI patients is high. The susceptibility of uropathogen antimicrobial resistance patterns to antimicrobials varies with age. In order to choose the best course of action for treating a UTI, it is necessary to regularly examine the trends in antibiotic susceptibility patterns.

Keywords: Antibiotic resistance, Urinary tract infection, Uropathogen, Urine culture

Introduction

One of the most common conditions that children suffer is UTI [1]. Age, sex, race, and status of circumcision all have an impact on the occurrence of UTIs [2]. On the other hand, the primary risk factors for the development of UTI include incomplete bladder emptying, urolithiasis, bladder and bowel dysfunctions, and congenital kidney and urinary tract abnormalities, immunocompromized and in association with other infection [3, 4].

Eight percent of children between the ages of one month and eleven will get a UTI at some point in their lives. UTI is most frequently caused by *E. coli*. However, compared to maturity, the first year of life is associated with a higher risk of urosepsis due to the prevalence of *Klebsiella pneumonia*, *Enterobacter* spp., *Enterococcus* spp., and *Pseudomonas* spp. [5].

The primary goals of treatment for pediatric UTIs are to resolve symptoms and avoid complications like sepsis, kidney abscess, and renal damage. Since kidney damage can only be avoided with an early diagnosis and appropriate antibiotic therapy [6]. The empirical antibiotic medication is typically started prior to obtaining a urine culture and an antibiotic susceptibility test is also carried out [6].

Antibiotic resistance to bacterial pathogens associated with UTIs is increasing globally, especially to common antibacterial agents. The appropriate empirical antibiotic treatment must therefore be started in accordance with the common etiological agents that are common in specific geographic areas [7].

This study sought to identify the causal bacteria in pediatric patients diagnosed with UTIs at Al-Mahmodyiah hospital who were younger than 15 years old. We also tried to find the frequencies of antibiotic resistance linked to these causing factors. By doing this, we help pediatric patients with UTIs receive proper empirical antibiotic treatment.

Methodology

It is a cross-sectional study done at Al-Mahmodyiah hospital in Baghdad; in period extending from 01 May 2020 to the 01 May 2023. The number of children involved in the study is 638 patient age below 15 years old, all patients visited outpatient clinic with different symptoms of UTI such as abdominal pain, dysuria, and fever. All patients are diagnosed with UTI according to the results of urine culture done at the laboratory of the hospital.

Sample collection

Urine samples taken midstream or by catheterization were collected in sterile containers. According to the American Academy of Pedi-

atrics, a UTI is defined as pyuria and the presence of 50,000 or more colonies in urine samples obtained through catheterization [8]. As a result, patients who meet these criteria are diagnosed with UTIs. The study excluded those who did not fit these requirements.

The VITE-K 2 (Biomereux-France) automated system was used to find antibiotic susceptibility tests after the identifying of the microorganism using a matrix-assisted laser desorption ionization time-of-flight mass spectrometry (MALDI-TOF MS; VITEK MS, bioMérieux, France) system. In accordance with the European Committees on Antimicrobial Susceptibility Testing (EUCAST), sensitivity limit values were assessed.

Data collection

We examined 638 samples from individuals with UTI. By getting information from the patients or relatives, the isolated bacteria and antibiotic resistance profiles were documented in a questioner along with the demographic data of patients. Statistical analysis was performed using portable SPSS 26.0

Results

Table 1 shows age and gender distribution of the patients, the infants (below 1 year), the infected male is 43 (14.6%) and female are 20 (5.8%) toddlers (1 - 3 year) infected male 58 (19.7%) and female 76 (22%), pre-school age (3 - 6 year) with infected male 96 (32.9%) and female 126 (36.6%) and school age (6 - 15 year) infected male 97 (32.9%) and female 122 (35.4%), with total male patients are 294 (46%), and female 344 (54%) with significant difference for all age groups.

Table 2 shows the results of urine culture for each age group, the table shows the number of patients below 1 year infected by E. coli spp. 20 (33%) and Klebsiella spp. is 3 (6%), and Protus spp. is 22 (36%), Enterococci spp. 9 (14%), Pseudomonas spp. 5 (7%), and other microorganisms 4 (6%) with significant p-value of patients with Protus spp. and E. coli infection.

From 1 - 3 years infected with E. coli 60 (45%), Klebsiella spp. 42 (31%), Protus spp. is 13 (10%), Enterococci spp. 8 (6%), Pseudomonas spp. 4 (3%) and other microorganisms 7 (5%) with significant p-value.

The patient at age 3 - 6 year infected with E. coli 158 (71.7%), Klebsiella spp. 15 (7%), Protus spp. is 9 (4%), Enterococci spp. 18 (8%), Pseu-

domonas spp. 4(2%) and other microorganisms 18 (8%) with significant p-value for E. coli infections.

The patient at age 6 - 15 years infected with E. coli 138 (63%), Klebsiella spp. 26 (12%), Protus spp. is 22 (10%), Enterococci spp. 15 (7%), Pseudomonas spp. 7 (3%) and other microorganisms 8 (4%) with significant p-value for E. coli infection.

Table 3 shows the number and percent of infected patients by E. coli and Klebsella spp. according to gender of age group, the table shows aged less 1 year male infected with E. coli is 14 (70%) of patients less than 1 year infected by E. coli and female is 6 (30%) with significant p-value, and with Klebsiella spp. male 3 (10%) and female 0 (0%) of total children below 1 year with significant p-value.

For patient with age 1 - 3 years, male patients infected with E. coli is 23 (32.8%) of infected male of such age and in female 46 (67.2%), and with Klebsiella spp. the male 17 (40.4%), and female 25(59.6%) with significant p-value.

For patients aged 3 - 6 years, infected male with E. coli is 62 (31.2%) of total infected male at such age group, and female 96 (60.7%), and with Klebsiella spp. male 4 (26.6%) and female is 11 (73.3%).

Finally, for patient aged 6 - 15-year, E. coli infect 36 (26%) of male from total infected male by E. coli at such age group, and 102 (74%) of female with significant p-value, and Klebsiella spp. infect 3 (11.5%) of male and 23 (88.5%) of female, with significant p-value.

Table 4 illustrates the gender difference according to age groups for Protus spp. and Enterococci spp., shows the infected male below 1 year with Protus spp. is 17 (77%) from total patients infected with Protus spp. below 1 year with significant p-value, while female is 5 (22.8%), and male with Enterococci spp. is 6 (66.6%) and female 3 (33.3%) with significant p-value.

In children aged 1 - 3 years male patient is 4 (30.7%) of total infected male with Protus spp. and female 9 (69.2%) with significant p-value, and for patients with Enterococci spp. male patient 3 (37.5%), and female 5 (62.6%) with significant p-value.

In children at aged 3 - 6 years, the male with Protus spp. infection is 4 (40%) and female is 6 (60%) with significant difference, while male of such age infected with Enterococci spp. 6 (33.4%), and female is 12

Table 1: Illustrate the sensitivity % for each antibiotic to main four bacteria causing UTI.

Age group	Patients, N	Male, N (46%)	Female, N (54%)	p-value
≤ 1year	63	43 (14.6%)	20 (5.8%)	0.0001
1 - 3 year	134	58 (19.7%)	76 (22%)	0.0031
3 - 6 year	222	96 (32.6%)	126 (36.6%)	0.00002
6 - 15 year	219	97 (32.9%)	122 (35.4%)	0.00009
Total	638	294 (100%)	344 (100%)	0.017

Table 2: Shows the results of urine culture in relation to age group.

Age group	E. coli, N %	Klebsiella spp., N %	Protus spp., N %	Enterococci spp., N %	Pseudomonas spp., N %	Others	Total, N %	p-value
≤ 1year	20 (33%)	3 (6%)	22 (36%)	9 (14%)	5 (7%)	4 (6%)	63 (100%)	0.062
1 - 3 year	60 (45%)	42 (31%)	13 (10%)	8 (6%)	4 (3%)	7 (5%)	134 (100%)	0.0034
3 - 6 year	158 (71%7)	15 (7%)	9 (4%)	18 (8%)	4 (2%)	18 (8%)	222 (100%)	0.0002
6 - 15 year	138 (63%)	26 (12%)	22 (10%)	15 (7%)	7 (3%)	8 (4%)	219 (100%)	0.00054
Total	376 (59%)	86 (13%)	66 (10%)	50 (7.8%)	20 (3%)	37 (5.7%)		

(62.6%) with significant p-value.

At patient with 6 - 15 years old, the number of male infected with *Protus* spp. is 4 (18%) while the female is 18 (88%) with significant p-value, while patient infected with *Enterococci* spp. at age 6 - 15 year the male is 5 (33.3%) and female is 10 (66.7%) with significant p-value.

Table 5 and figure 1 shows antibiotic sensitivity for the 4 most common microorganisms, from table, can see the *E. coli* is highly sensitive to meropenem 368 (98%) and nitrofurantoin 357 (95%), while least sensitive to cefepim 56 (15%) and trimethoprim-sulfamethaxazole 113 (30%), while *Klebsiella* spp. is sensitive to meropenem (98%) and gentamicin (88%) and less sensitive to ampicillin (22%) and cefepim (31%), *Protus* spp. is mainly sensitive to meropenem (95%) and gentamicin (90%) and least sensitive to cefepim (5%), and trimethoprim-sulfamethaxazole (26%) and finally *Enterococci* spp. is highly sensitive to meropenem (90%), and nitrofurantoin (91%) and less sensitive to cefepim (14%) and trimethoprim-sulfamethaxazole (21%).

Discussion

In this study, we aimed to study the age and gender affected with UTI in children less than 15 years, also determine the causative microorganisms in Al-Mahmodyiah general hospital and to conclude the antibiotic resistance rates of these microorganisms, From study at table 1,
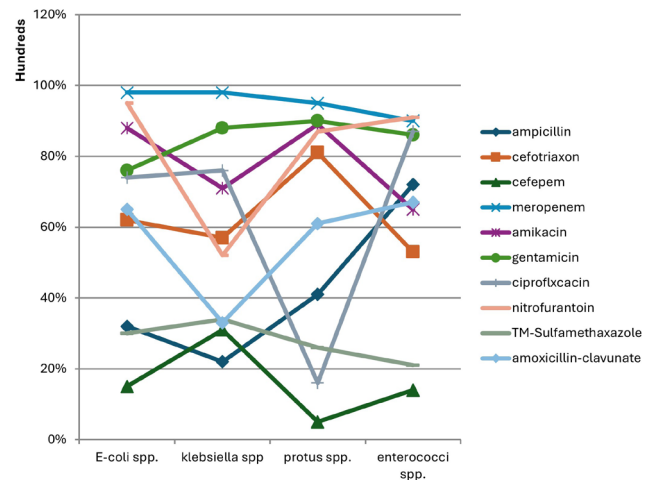

Figure 1: Illustrate the sensitivity % for each antibiotic to main four bacteria causing UTI.

we see the most age group develops UTI in general for both genders is 3 - 6 years and 6 - 15 years, and that can be explained by the awareness of their age groups to the symptoms of UTI such as dysuria and abdominal pain, and this finding is highly correlates with [9, 10].

Also, the frequency of UTI is different according to gender, the UTI is common in female in all age groups except in infants less than 1

Table 3: Shows the comparison between both genders according to age groups of children infected with *E. coli* spp. and *Klebsiella* spp.

Age	Gender	E. coli spp. N %	p-value	Klebsiella spp., N %	p-value
0 - 1 year	Male	14 (70%)	0.0006	3 (100%)	0.000001
	Female	6 (30%)		0 (0%)	
1 - 3 year	Male	23 (32.8%)	0.00087	17 (40.4%)	0.00034
	Female	46 (67.2%)		25 (59.6%)	
3 - 6 year	Male	62 (31.2%)	0.00493	4 (26.6%)	0.000021
	Female	96 (69.8%)		11 (73.3%)	
6 - 15 year	Male	36 (26%)	0.00001	3 (11.5%)	0.0000013
	Female	102 (74%)		23 (88.5 %)	

Table 4: Shows the comparison between both genders according to age groups of children infected with *Protus* spp. and *Enterococci* spp.

Age	Gender	E. coli spp. N %	p-value	Klebsiella spp., N %	p-value
0 - 1 year	Male	17 (77.2%)	0.0008	6 (66.7%)	0.004
	Female	5 (22.8%)		3 (33.3%)	
1 - 3 year	Male	4 (30.7%)	0.0056	3 (37.5%)	0.006
	Female	9 (69.2%)		5 (62.5%)	
3 - 6 year	Male	4 (40%)	0. 021	6 (33.4%)	0.007
	Female	6 (60%)		12 (62.6%)	
6 - 15 year	Male	4 (18%)	0.0001	5 (33.3%)	0.0032
	Female	18 (88%)		10 (65.7%)	

Table 5: Shows antibiotic sensitivity for each microorganism.

Antibiotic	E. coli spp. N %	Klebsiella spp. N %	Protus spp. N %	Enterococci spp., N %
Ampicillin	120 (32%)	19 (22%)	24 (41%)	36 (72%)
Ceftriaxone	233 (62%)	49 (57%)	53 (81%)	27 (53%)
Cefepim	56 (15%)	27 (31%)	3 (5%)	7 (14%)
Meropenem	368 (98%)	84 (98%)	63 (95%)	45 (90%)
Amikacin	330 (88%)	61 (71%)	59 (89%)	33 (65%)
Gentamycin	286 (76%)	75 (88%)	60 (90%)	43 (86%)
Ciprofloxacin	280 (74%)	65 (76%)	11 (16%)	43 (87%)
Nitrofurantoin	357 (95%)	445 (52%)	57 (87%)	45 (91%)
Trimethoprim-Sulfamethaxazole	113 (30%)	29 (34%)	17 (26%)	11 (21%)
Amoxicillin-Clavunate	144 (65%)	28 (33%)	40 (61%)	33 (67%)
p-value	0.008	0.0068	0.0054	0.0092

year old, that may be explained that non-circumcised male around this age may increase risk of UTI in male patients, and this is agreed with [9, 11, 12].

Table 2 illustrates the results of culture for patients and distributed according the age group, and shows the most common microorganism cause UTI in infants less than 1 years is *Protus* spp. and *E. coli*, and this can be explained that infection can be taken from birth canal during delivery or nosocomial infection after delivery also ascending infection from genitalia, this finding disagreed with [13, 14] who illustrate that most common cause of UTI below 1 year age is *Enterococci* spp. and this differences can be described as the endemic geographic distribution, also in the other age groups; the most common infecting microorganism is *E. coli* spp. In both genders, and this finding is agreed with [14].

Table 3 compares the male and female infection according age group for the infection with *E. coli* and *Klebsiella* spp.

For *E. coli* infection. in all age group the female is infected more than male except in infants below 1 year the male is more infected than female, and this correlate with [14] and for *Klebsiella* spp. infection, the same scenario, it infects female more than male in all age groups except age below 1 years, and this is agreed with [14, 15].

Table 4 compares the number and percent of patients infected with *Protus* spp. and *Enterococci* spp. For both microorganisms, the infected female is more predominant than male except infants below 1 year the male infection is more, and this finding is resembled with [16].

Table 5 and figure 1 show antibiotic sensitivity according the results of culture and sensitivity for each microorganism, for each microorganism may be sensitive for more than one antibiotic, and the table shows the *E. coli* is highly sensitive to meropenem and nitrofurantoin, and less sensitive to cefepem and trimethoprim-sulphamethxazole are high resistant can easily explained by the widely use antibiotics in outpatient clinic even without prove the presence of UTI, also poor drug adherence may increase antibiotic resistance and this correlates with [15, 16] who stat the most effective antibiotic for UTI patient is meropenem, aminoglycosides and nitrofurantoin.

In *Protus* spp., *Klebsiella* spp., and *Enterococci* spp. the most effective injectable antibiotic is meropenem and gentamicin, while both are less sensitive to cefepim, trimethoprim-sulfomethxazol, and ampicillin and this is explained by the same reason mentioned above, and these findings is near resemble with [15, 16].

Conclusion

The rate of UTI in children below 15 years old usually in female more than male except in infants below 1 years old, the male is more than female. There is a difference in rate of UTI according to age group, higher rate of infection at age is 3 - 15 years old, and that may be higher awareness of signs and symptoms. The most common microorganism that causes UTI is *E. coli*. Except at male infants less than 1 year, the *Protus* spp. is higher rate of infection? The higher sensitivity rate for antibiotics according to culture finding for most common microorganism to meropenem, and nitrofurantoin for *E. coli* and *Enterococci* spp., and the gentamicin for *Klebsiella* spp. and *Protus* spp. and all microorganisms are highly resistant to cefepim. Children with UTI at outpatient clinic, the best empirical antibiotics is nitrofurantoin, can be given before re-

sults of culture and sensitivity, while in admitted children, parenteral meropenem is the most effective. Avoid cefepim and ampicillin as an empirical antibiotic for UTI because of the high rate of resistance. All children with symptomatic UTI, and GUE support the diagnosis, culture should be done. Avoid use of antibiotics without strong indications to prevent bacteria's antibiotic resistance.

Acknowledgements

Conflict of Interest

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