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Antimicrobial susceptibility of *Escherichia coli* Isolates from Clinical Specimens in Children over a 5-Year Period in Jordan

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ABSTRACT

The present study was conducted to investigate antimicrobial susceptibility pattern of *Escherichia coli* strains isolated from clinical specimens of Jordanian pediatric patients during a five year period 2005-2009. A total of 2259 *E. coli* strains were isolated from different clinical specimens and tested for their susceptibility to commonly used antimicrobial agents. Overall, high susceptibility rate was observed for nitrofurantoin (90.4%), followed by ciprofloxacin (85.6%), norfloxacin (83.9%), cefotaxime (83.7%), ceftriaxone (82.4%), and gentamicin (80.8%). Lower susceptibility rates were observed for ampicillin (19.8%) followed by amoxicillin-clavulanic acid (26.8%) and cotrimoxazole (31.6%). Nitrofurantoin was highly effective for *E. coli* with susceptibility rate of 90.4%. In contrast, ampicillin, amoxicillin-clavulanic acid and cotrimoxazole were found to be ineffective at in vitro for inhibition of the *E. coli* of pediatric origin.

Key words: Antimicrobial resistant, *Escherichia coli,* pediatric patients.

INTRODUCTION

Antimicrobial resistance has become a serious public health problem worldwide. Infections caused by resistant bacteria have been shown to be more frequently associated with increased morbidity and mortality than those caused by susceptible pathogens[1,2]. In areas of concentrated use, such as hospitals, this had led to lengthened hospital stays, increased health care costs and in extreme cases, to untreatable infections[3].

The main cause of nosocomial infections in humans is *Escherichia coli*. It's also a common inhabitant of the human and animal gut and is considered an indicator of fecal contamination in food. *E. coli* is one of the organisms most frequently isolated from different clinical cases of diarrhea and others[4, 5]. Several factors results in increasing antimicrobial drug resistance rates in poor countries such as irrational antimicrobial drug usage and conditions of poor sanitation[4-6]. Many studies have demonstrated increases in antimicrobial resistance among pathogenic bacteria after introduction of an antimicrobial[7,8]. Despite world-wide use of antibiotics, the distribution of the resistance is far from being uniform even in the same area[9]. However, there is little information on antimicrobial resistance pattern in Jordan. Therefore, this retrospective study was conducted to determine susceptibility rate to commonly used antibiotics by *E. coli* strains isolated from cultures of different clinical specimens received from pediatric patients at Princess Rahmah Hospital during a five year period 2005-2009.

MATERIALS AND METHODS

This study was carried out in the diagnostic Medical Microbiology Laboratory of Princess

Rahmah Hospital located in Irbid, Jordan, during 2005-2009. A total of 2259 bacterial isolates were identified from different clinical specimens using standard bacteriological methods. These clinical specimens included urine, blood, ear and conjunctival swabs. Microbiological and antibacterial susceptibility data of this study obtained from records of diagnostic Medical Microbiology Laboratory of Princess Rahmah Hospital. These data were filled in a prepared data sheet. The antimicrobial susceptibility patterns of these isolates to antibiotics were determined using the Kirby-Bauer method of disc diffusion test[10]. The isolates were tested against the following antibiotics; amikacin, amoxicillin-clavulanic acid, ampicillin, cefaclor, cefixime, cefotaxime, ceftazidime, ceftriaxone, cephalothin, cephalexin, ciprofloxacin, cotrimoxazole, gentamicin, nalidixic acid, nitrofurantoin and norfloxacin. The study protocol was approved by the Ethics Committee of the ministry of health in Jordan (MOH, REC, 08, 0057).

Statistical Analysis

Data were analyzed using SPSS (version15 for Windows) to calculate the frequencies and cross tables.

RESULTS

During a five year period (2005-2009), a total of 2259 positive *E. coli* cultures of pediatric patients aged below 15 years old were studied. The distribution of *E. coli* strains from various clinical specimens was shown in table 1.

Overall, high susceptibility rate was observed for nitrofurantoin (90.4%), followed by ciprofloxacin (85.6%), norfloxacin (83.9%), cefotaxime (83.7%), ceftriaxone (82.4%), and gentamicin (80.8%). Lower susceptibility rates were observed for ampicillin (19.8%) followed by amoxicillin-clavulanic acid (26.8%) and cotrimoxazole (31.6%), (Table 2).

Table 1: Distribution of *E. coli* isolates in different clinical specimens

Clinical specimen	Year					Total
	2005	2006	2007	2008	2009	%
Urine	459	433	409	435	457	2193
Ear swab	3	0	0	16	15	39
Eye swab	4	6	3	3	0	16
Blood	4	0	0	7	0	11
Among all specimens	470	439	417	461	472	2259

DISCUSSION

This current study provides information regarding the distribution of pathogenic *E. coli* isolates and its antimicrobial susceptibility patterns in pediatric patients. Most *E.coli* strains isolated from urine samples (97%). This is likely related to contamination with colonic bacteria[11].

Results of this study showed high resistance rate of *E. coli* isolates to antimicrobial agents tested. Similar findings regarding high potentials for developing resistance for pathogenic isolates of *E.coli* were reported in literature. [12] High resistance rate to ampicillin, amoxicillin-clavulanic acid and cotrimoxazole was obtained. These results coincide with results reported high resistance rate of *E. coli* isolates to ampicillin and amoxicillin in Jordan[13] and elsewhere[14,15]. This high resistance rate is may due to the widespread and lengthy use of these antibacterial drugs in the world including Jordan. Susceptibility rates of *E. coli* isolates from different clinical specimens was highly significant deceased *(P<0.01)* to ceftazidime, cefotaxime, cephalothin and nalidixic acid in comparison between the years of 2005 vs. 2009. By the way, amoxicillin-clavulanic acid, cephlexin and cotrimoxazole were also showed decreases in their activity, but this decrement was not significant. The

Table 2: Susceptibility *E. coli* isolates from different clinical specimens in children to various antimicrobials

Number (%) of *E-coli* susceptible to P-value	2005 N= 470	2006 N=439 N (S %)	2007 N= 417 N (S %)	2008 N=461 N (S %)	2009 N=472 N (S %)	Total N= 2259 N (S %)	Significance 2005 vs. 2009 N (S %)
AMC	132 (30.3)	305 (26.8)	383 (28.7)	361 (27.9)	409 (22.9)	1590 (26.8)	0.091
AMP	266 (4.8)	371 (4.3)	375 (18.1)	347 (16.7)	161 (90.6)	1520 (19.8)	<0.001
CAZ	92 (92.3)	6 (66.6)	20 (45)	115 (74.7)	138 (73.9)	371 (77.0)	<0.001
CEC	191 (49.7)	139 (63.3)	334 (69.7)	390 (67.1)	379 (73.6)	1433 (66.7)	<0.001
CF	138 (52.8)	320 (86.5)	398 (81.1)	183 (71.0)	383 (56.9)	1422 (71.8)	0.416 (NS)
CFX	117 (64.9)	122 (63.9)	112 (71.4)	308 (79.2)	327 (61.1)	986 (68.7)	0.234 (NS)
CLT	179 (51.9)	220 (11.3)	203 (45.8)	206 (59.2)	107 (33.6)	915 (40.3)	<0.01
COT	338 (31.6)	363 (32.5)	410 (35.3)	379 (30.0)	287 (27.5)	1777 (31.6)	0.261 (NS)
CPR	412 (85.6)	272 (86.3)	343 (84.5)	408 (85.7)	319 (85.8)	1754 (85.6)	0.935 (NS)
CTR	18 (66.6)	5 (0)	397 (83.8)	14 (92.8)	39 (82.0)	473 (82.4)	0.205 (NS)
CTX	414 (85.9)	400 (86.7)	29 (72.4)	389 (89.4)	290 (70.0)	1522 (83.7)	<0.001
GEN	430 (78.3)	388 (79.6)	392 (80.8)	374 (82.6)	398 (82.9)	1982 (80.8)	0.099 (NS)
NAL	430 (61.6)	404 (57.6)	394 (59.8)	401(52.6)	399 (45.6)	2028 (55.5)	<0.001
NIT	248 (79.8)	56 (98.2)	210 (95.7)	20 (90.0)	168 (97.0)	702 (90.4)	<0.001
NOR	401 (83.0)	412 (827)	392(84.4)	395 (83.5)	395 (86.0)	1195 (83.9)	0.237 (NS)

Number of isolates (N), Sensitive (S), Not significant (NS)

Amoxicillin-Clavulanic acid (AMC), Ampicillin (AMP), Ceftazidime (CAZ), Cefaclor (CEC), Cefixime (CF), Cephlexin (CFX), Cephalothin (CLT), Cotrimoxazole (COT), Ciprofloxacin (CPR), Ceftriaxone (CTR), Cefotaxime (CTX), Gentamicin (GEN), nalidixic acid (NAL), Nitrofurantoin (NIT), Norfloxacin (NOR).

cause of decrement in the activity of above antimicrobial agents is may due to the widespread and lengthy use of these antimicrobial drugs in the world including Jordan. These results are in accordance with other studies that reported high resistance rates of *E. coli* isolates against various antibiotics from various clinical specimens[13-15].

In contrast, susceptibility rates of *E. coli* isolated from different clinical specimens' showed improvement to ampicillin, cefaclor, nitrofurantoin, cefixime, ciprofloxacin, ceftriaxone, gentamicin, norfloxacin in comparison between the years of 2005 vs. 2009. This increment was highly significant *(P<0.001)* for ampicillin, cefaclor, nitrofurantoin. These results coincide with another studies conducted elsewhere.[16-18]. The cause of significant improvement in the activity of imipenem and pipracillin is may due to little use of these medicines in treatment of bacterial infection in children.

E. coli isolates remained to be relatively susceptible to third generation cephalosporins but exhibited moderate susceptibility rates to first and second generation cephalosporins. For example, high susceptibility rates to cefotaxime (83.7%), ceftriaxone (82.4%), ceftazidime (77.0%) and cefixime (71.8%) were observed in this study, which is similar to other findings reported in Jordan[13] and elsewhere[14]. However, high resistant rates of *E. coli* to third generation cephalosporins were reported in different studies[16, 17]. Oral use of cefixime may results in increased its resistant rate compared to injectable third generation cephalosporins. Furthermore, *E. coli* in present study showed low resistant rate to fluoroquinolones i.e. ciprofloxacin and norfloxacin of 14.4 % and 16.1% respectively. Similar finding were reported in Jordan[13]. However, high resistant rates of *E. coli* to fluoroquinolones were reported else where[16,17].

Over all antibacterial tested in this study, nitrofurantoin was the most effective agent against *E. coli* with susceptibility rate of 90.4%. This result

coincide with a study reported a very low resistant rate of *E. coli* to nitrofurantoin even after 50 years of use[19].

There are many possible reasons for increasing resistant rate of *E. coli* to common used antimicrobial drugs, including inappropriate and incorrect administration of antimicrobial agents in empiric therapies and lack of appropriate infection control strategies[20-21]. This problem indicates importance of performing antibiotic susceptibility testing before blind antibiotic therapy.

CONCLUSION

The data suggest that ampicillin, amoxicillin-clavulanic acid and cotrimoxazole should not be used in treating infections caused by pathogenic *E. coli* and other related bacteria in Jordan. These findings also reinforce the need for ongoing investigation to show trends in antibiotic resistance, which can help clinicians provide safe and effective empiric therapies. Moreover, the data would also help authorities to formulate antibacterial prescription policies.

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