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Isolation and Antibiotic Susceptibility Profile among Urinary Catheter and Non-Catheter *Escherichia coli* Isolates

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Abstract : Urinary tract infections (UTIs) are among the most common infectious diseases of humans, with *Escherichia coli* being responsible for >80% of all cases. The study was conducted to isolate and determine the antibiotic resistance in *E. coli* from urinary tract infections from AL-Yarmouk Teaching Hospital in Baghdad. Widespread use of antibiotics has led to the emergence of resistant bacteria. As the antibiotic sensitivity profile of the bacteria is frequently changing, this retrospective analysis was designed to assess the recent antibiotic sensitivity among urinary catheter and non-catheter *Escherichia coli* isolates. A total of 129 clinical urine specimens were collected from patients suffering from urinary tract infection 92 from hospital urinary catheterized patients and 37 non-catheterized patients. The sensitivity pattern of *E. coli* isolates to antibiotics in UTI were amoxicillin/clavulanic acid (65.11%), cefotaxime (69.76%), ceftazidime (62.79%), ceftriaxone (72.09%), ciprofloxacin (60.46%), gentamicin (46.51%), imipenem (0%), meropenem (0%) and nitrofurantion (0%) hence *E. coli* considered as a multidrug resistant organism.However, the percentage of antibiotics resistant isolates was statistically significant difference in urinary catheter compared to non-catheter *Escherichia coli* isolates.
Keywords : Urinary Tract Infections, *Escherichia coli*, Antibiotics, resistant.

Introduction

Urinary tract infections are a community-acquired bacterial disease which frequently affects human especially female outpatients[1]. It is the second most common bacterial infectious diseases despite the widespread availability of antibiotics. It encountered at all ages and the recurrence rate is high often become chronic, therefore, it is an important public health problem[2, 3].

Risk factors of UTIs include infants, pregnant women, elderly, patients with spinal cord injuries and/or catheters, patients with diabetes, or immunosuppression and patients with urologic abnormalities[4].

Uropathogenic *Escherichia coli* (UPEC) are the most predominant pathogen causing UTIs[5]. It the primary causative agent of complicated and uncomplicated UTI’s responsible for approximately (80%) of community acquired and (50%) of nosocomial-acquired UTIs, it is isolated from the urine of about 30% of patients experiencing catheter-associated urinary tract infections (CAUTI)[6].

Indwelling urinary catheters are standard medical devices utilized in both hospital and nursing home settings to relieve urinary retention and urinary incontinence[7].

CAUTIs, the most common type of nosocomial infection, account for over 1 million cases annually or over 40% of all nosocomial infections in hospitals and nursing homes and constitute 80% of all nosocomial UTIs[8].

Antibiotic resistance of pathogens in the management of complicated and uncomplicated community-acquired UTIs is a serious medical problem because of their characteristic of very fast rise and spread of mutant strains and hence these are insusceptible to medical treatment. Bacterial resistance to antibiotics complicates the treatment of UTI and the antibiotic sensitivity pattern shows geographical variations[9].

Management of UTI has become difficult due to increased bacterial resistance to antibiotics. By and large, up to 95% of the cases with severe symptoms are treated without bacteriological investigations[10].The present study was designed to assess the recent resistance rates and surveillance study of *E. coli* in the management of UTI and this may help the medical practitioners to prescribe the right empirical treatment[11].

Materials and Methods

Collection of specimens

During the period from November 20014 to February 2015, A total of 129 clinical urine specimens were collected from patients suffering from urinary tract infection of all the age groups and both sexes admitted to AL-Yarmouk Teaching Hospital in Baghdad; 92 from hospital urinary catheterized patients and 37 non-catheterized patients. Specimens were collected aseptically as follow:

A) Urine specimens from non-catheterized patients: Specimens was collected from 37 patients, patients were carefully educated to collect a proper specimen by themselves; sterile dry wide necked leak proof containers were used for urine collection, collected mid-stream urine and directly were transferred to the laboratory.

B) Urine specimens from catheterized patients:92 patients with Foley urinary catheterization, the urine specimens for culture should be collected directly from the catheter or tubing, to maintain a closed drainage system using aseptic technique by puncturing the urinary catheter tubing with a sterile needle and syringe from the distal ends of the urinary catheters and they were transferred to sterile urine containers and transported immediately to the laboratory without any delay. Culture specimens should not be obtained from the drainage bag[12].

Identification of *E. coli* isolates

The specimens received were inoculated on and MacConkey, Eosin Methylene Blue and blood agar plates. Then all plates were incubated at 37°C for 24hrs.

Significant isolates were identified as species level using conventional bacteriological methods and analytical profile index (API)-20E system was employed to confirm the identification.

Antimicrobial susceptibility testing

Susceptibility testing to antibiotics was performed by disk diffusion methods using Kirby-Bauer method as recommended by clinical laboratory standard institute[13]. Susceptibility test was conducted for all *E. coli* isolates against nine antibiotics; included β-lactam antibiotics (cefotaxime (30), amoxicillin/ clavulanic acid (30 (20/10), ceftriaxone (30), ceftazidime (30), fluoroquinolones (ciprofloxacin (5), carbepenems (imipenem (10), meropenem (10), Aminoglycosides (gentamicin (10) and nitrofurantion (300). According to the suggestion of CLSI[13], the results were interpreted.

Statistical Analysis

Comparisons of prevalence data were tested using Chi square ($\chi 2$) test and Fisher's exact test with GraphPad prism (version 6) statistical software.

Results and discussion

Isolation and identification of *E. coli* isolates

After performance the identification tests it was found that in a total of 43 (33.3%) *E. coli* isolates, 21(22.8%) isolates were from hospital urinary catheterized patients and 22 (59.4%) isolates were from non-catheterized patients of urine specimens(Figure 1).

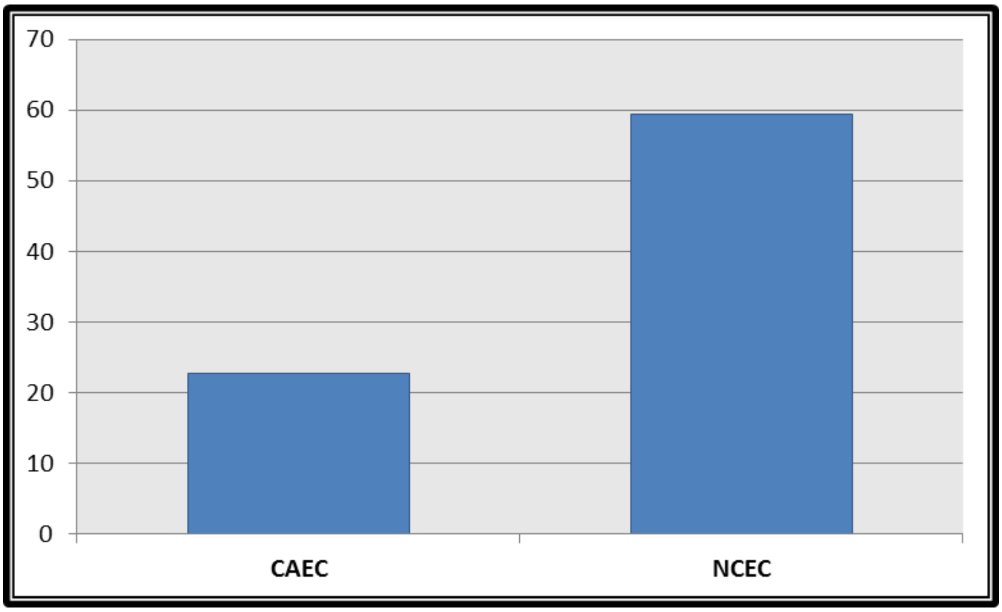

Figure 1: Percentage of uropathogenic *E. coli* (UPEC) from catheterized and non-catheterized patients

This finding revealed that the UPEC strains were able to be one of the major causative agents of UTIs in Iraq. *E. coli* is a normal inhabitant of the intestinal and vaginal tracts; these sites can serve as potential reservoirs for UTIs and CAUTIs in accordance to previous observations[8].

It is approximately similar to the isolation percentage recorded by Niranjan and Malini[14]which was 56.8% of different uropathogens.

Local study done by Ibrahim[15]recorded that *E. coli* was isolated in a percentage 65.8% in urine samples from patients suffering from urinary tract infections, while Shaaban *et al.*[16]and Hassan[17] was isolated *E. coli*in a percentage 43.75% and 40.86% respectively.

Seventy-six urine specimens were collected from of patients suffering from recurrent urinary tract infections (UTIs) and fifty (65.8%) of isolated bacterial strains were belonged to *E.coli*[18].

In a comparison to the isolation percentage of *E.coli* from patients with urinary catheter, *Escherichia coli* being most often nosocomial species were found colonizing the catheters[19].The elderly patients are at increased risk for unnecessary catheterization[20].

Gould *et al.*[21]was recorded that *E. coli* accounted for 26% and was the commonest etiologic agent in catheter associated urinary tract infection.

Similarly Hidron*et al.*[22]showed that the *E. coli* was the most frequent occurring pathogen associated with CAUTI (21.4%) in hospitals. These isolation percentages were approximately similar to the isolation percentage of this study.

Niveditha *et al.*[23]recorded the isolation percentage of uropathogens, that from a total of 50 urine samples were analyzed the isolation percentage of *E.coli* among bacterial isolates was 70% from catheterized patients with symptoms of UTI.

Although many reports were pointed that *E.coli* represent important uropathogene for complicated UTIs of catheterized patients but the result of this study showed low frequency because the samples were obtained from patients possessing catheter for (3-5 days) and the *E.coli* bacteria prefers long term catheterized urinary tract or the patients may obtained a high dose of antibiotic which inhibits *E.coli* before and after using of catheter. This result was nearly in constituent with recently Iraqi study by Makia *et al.*[24]who reported that the percentage of *E.coli* isolated from urine of catheterized patients was 2.57%.

Antibiotic susceptibility pattern of *E. coli* isolates

The results showed that there was an observed variance in the susceptibility to different antibiotics among isolates.

The results presented in figure 2show that *E. coli* isolates were resistant to amoxicillin/ clavulanic acid (65.11%),cefotaxime (69.76%),ceftazidime (62.79%), ceftriaxone (72.09%), ciprofloxacin (60.46%), gentamicin(46.51%),imipenem (0%), meropenem (0%) and nitrofurantion (0%)hence *E. coli* considered as a multidrug resistant organism.

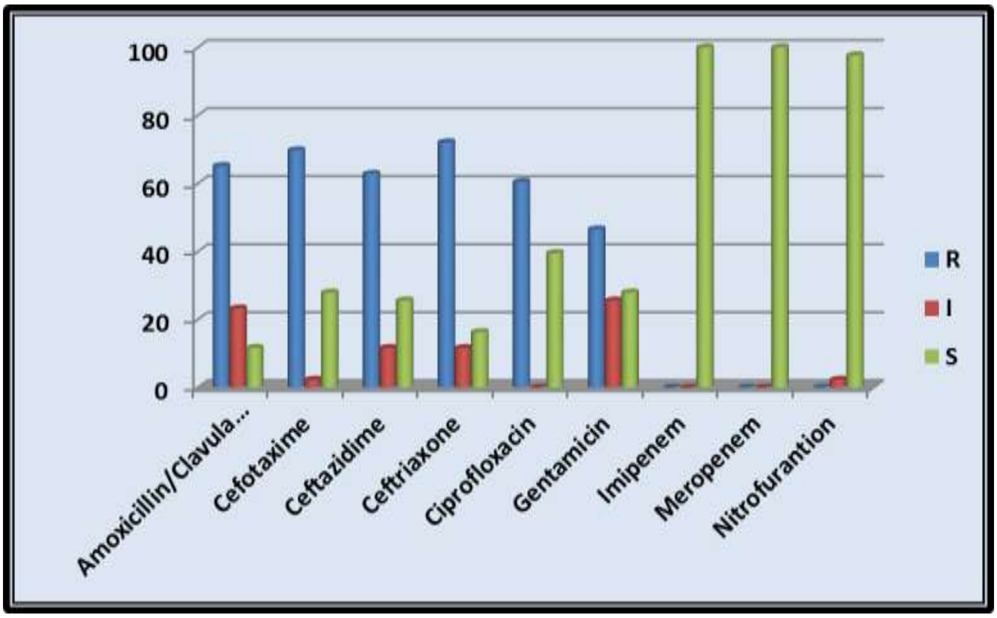

Figure 2: Antibiotics susceptibilitypercentages of *Escherichia coli* isolates

A high level resistance of *E. coli* clinical isolates to most of the antibiotics under test were noticed and results of resistance for some antibiotics of the present study might have a proximity to some other studies. In the present investigation all isolates of catheterized and non- catheterized patients was observed susceptible to both imipenem and meropenem. These results are corresponding to results obtained by Alipourfard and Nili[25] how found that sensitivity values to imipenem and meropenem were 100% for both.The same results were obtained from *E. coli*strains isolated from 166 urine specimens of UTI patients in South India[26].

However, the carbapenems are antimicrobials that are usually kept in reserve. In the case of non life-threatening infections and in non-outbreak situations, it is not necessary to administer carbapenems. This approach intends to preserve the therapeutic value of these precious drugs[27].

Resistance to Amoxyclav was 65.11%. Rerambiah *et al.*[28]found that the resistance rates to the combination amoxicillin and clavulanic acid in strains of *E. coli* in their setting was 66%. While Niranjan and Malini[14] mentioned that *E. coli* isolates isolated from patients with UTI showed high levels of resistance 74.4% to Amoxicillin-clavulanic acid, in contrast 31.3% was reported by López-Banda *et al.*[29].

Fluorquinolones and gentamicincan be an option to treat UTIs, but their utility is hampered by resistance rates. study done by Sharma *et al*.[30]showed that in a total of 152 isolates of *E. coli* isolates from different samples showed resistance rates range to ciprofloxacin (89.8%), gentamicin (65.8%) and cefotaxime

(88.6%), while 40% gentamicin and 38%ciprofloxacin percentages reported by Marhova *et al.*[31]in UPEC patients and López-Banda *et al*.[29]study found 62.3% resistance for ciprofloxacin, whereas resistance rates mentioned by Maheswari *et al*.[32]were 34.78% for gentamicin and 43.47% for ciprofloxacin;fluoroquinolones are indeed very effective in stopping the growth of a biofilm.

Interestingly, the results of the present study proved that all isolates of *E. coli* were highly resistant to the third generation of cephalosporins. Resistance of ceftazidime, which is a member of third generation of cefalosporins, in this study was 62.79%, and this is fair according to the results obtained from Ansari*et al.*[33]who found that the resistance of UPEC to CAZ was 52%. A study done by Igwe*et al.*[34] reported that 70% of *E. coli* isolates were resistant to ceftazidime. Whereas Tabasi *et al.*[35]mentioned 36% of the isolates were resistant to CAZ.

The antimicrobial susceptibility of 28 urine isolates reported high antibiotics resistance; that the *E. coli* isolates were cefotaxime resistant (85.7%) and ceftriaxone (78.5%)[27], while Tabasi *et al.*[35]in a study on UPEC showed the ceftriaxone resistance percentage was 41% and resistance rates tocefotaxime recorded by Ayatollahi*et al.*[36]and Nalini *et al.*[37]were 36.6%and 77.7%respectively.

Nitrofurantoin shows a good activity against UPEC isolates with only 3.8% and 2% resistant isolates[38, 31]respectively. Soto*et al.*[39] mentioned that the isolates showed the highest sensitivity to nitrofurantion(94.9%), however, dosage and potential pulmonary and liver toxicity limits their usefulness.

Thus, the use of other antibiotics such as nitrofurantoin and imipenem is recommended for treatment of UTI patients, the increased occurrence of UTI due to MDR *E. coli* could be due to increased consumption of antibiotics, self-medication and misuse[35].

Nevertheless, in this study resistant strains as well as multidrug resistance (MDR) strains were statistically significant different more often isolated from urinary catheterized patients (Table 1), which is not surprising as such patients are more often treated with antibiotics[40].

However, the percentage of antibiotics resistant isolates was statistically significant difference in urinary catheter compared to non-catheter *Escherichia coli* isolates.

Table 1: The resistance percentages of *E. coli* isolates to antibiotics from catheterized and non-catheterized patients

Antibiotic	CAEC	NCEC	P value
	R	R	
Amoxicillin/ Clavulanic acid	85.71	45.45	<0.0001**
Cefotaxime	76.19	63.63	0.0871*
Ceftazidime	66.66	59.09	0.8579 Ns
Ceftriaxone	76.19	68.18	0.8871 Ns
Ciprofloxacin	80.95	40.90	0.0054**
Gentamicin	57.14	36.36	0.4021*
Imipenem	0	0	0
Meropenem	0	0	0
Nitrofurantion	0	0	0

R: Resistant **NS:**Non-significant

Despite prominent role of *E. coli* in CAUTIs, limited researches specifically addressing UPEC and its ability to cause these types of infections has been performed. Because of this, this study focuses on the most recent developments in the research on UPEC and its antibiotics profile[8].

Multivariate analysis of multi-resistant uropathogens showed a positive significant correlation with indewelling bladder catheter[41]. The urine of patients with indwelling catheters is the major site of isolation of resistant gram negative organisms, including extended spectrum beta-lactamase (ESBL) producing Enterobacteriaceae and CRE carbapenem-resistant Enterobacteriaceae[42].

Interestingly, the study by Alś *et al.*[43]showed that resistance to ciprofloxacin was higher in UPEC recovered in complicated UTIs (19.5%) than in UPEC isolated in uncomplicated UTIs (8.5%).

In contrast an interesting finding in Watts *et al.*[44]study that there was no significant difference in the number of ABU and CA-ABU strains resistant to each antibiotic and displayed very similar antibiotics resistance profiles from both catheterized and noncatheterized patients.

Additionally antibiotic bacteria resistance to antibiotics is influenced by their ability to form biofilms[45]; therefore the establishment of bacterial biofilm communities on urinary catheters is believed to inhibit the effectiveness of antibiotic treatment. Indeed, in intensive care units, CAUTI can be caused by bacteria that are resistant to all known antibiotics[46].

Conclusion

Uropathogenic *Escherichia coli* (UPEC), the primary causative agent of complicated and uncomplicated UTI's, it isolated in a higher isolation percentage from hospital urinary non-catheterized patients than from catheterized patients properly because the patients may obtained a high dose of antibiotic which inhibits *E. coli* before and after using of catheter. A high level resistance of *E. coli* clinical isolates to most of the antibiotics under test were noticed and the percentage of antibiotics resistant isolates was statistically significant difference in urinary catheter compared to non-catheter *Escherichia coli* isolates. However, the carbapenems is the most effective antibiotics. Widespread use of antibiotics has led to the emergence of resistant bacteria.

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