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The study of antibiotic resistance in *Escherichia coli* infections with an emphasis on the strains of ESBL

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ABSTRACT: Urinary tract infection is the second most common infection in the society and the major cause of the patients going to the hospital. The present study has been done aimed to determine the results of culture and the amount of antibiotic susceptibility in urinary tract infections. In this study, all the cases of urinary tract infection with positive cultures in admitted patients in general and infectious disease and ICU sections at Bu Ali Sina Hospital, who were hospitalized in May 2013 to May 2014, were enrolled. Samples without pyuria and asymptomatic were excluded due to the high probability of infection. For all eligible persons, a pre-designed questionnaire included demographic and clinical data was completed by trained interviewer. 129 patients, including 72 women (55.8%) and 57 men (44.2%) were enrolled. Among the 129 samples collected, *Escherichia coli* (*E. coli*) was the most common organism which was obtained from sample of 75 patients (58.1%) and 17 cases (21.9%) obtained from *E. coli* organisms were Extended-spectrum beta-lactamase (ESBL). In the case of *E. coli* sensitivity to Ceftriaxone, none of the two variables of complicated urinary tract infection and history of antibiotic use were independent predictors of antibiotic susceptibility (P> 0.05). Also in the case of *E. coli* sensitivity to Co-trimoxazole, none of the two variables of urinary catheter in the last year and indwelling urinary catheter were independent predictors of antibiotic susceptibility (P> 0.05).

Keywords: Urinary tract infection, antibiotic susceptibility, *Escherichia coli* ,ESBL

INTRODUCTION

Urinary tract infections are the second most common infection in society and the reason for 2% visits to the general practitioners as well as one of the major causes of patients visiting hospital (Pace *et al.,* 2004). The annual prevalence of these infections is about 1% and 11% in men and women, respectively. It is also anticipated that a minimum of 50% of women will experience a period of urinary tract infection during their lifetime. Urinary tract infections annually affect 150 million people worldwide and an annual cost of 6 billion dollar is spent on its treatment only in America (Gonzalez *et al.,* 1999). About 65% to over 95% of urinary tract infections are created by a type of bacteria, namely *Escherichia coli* (*E. coli*). Hence the focus of most studies which have been done on the amount of antibiotic resistance in urinary tract infections have been on the same organism (Kahlmeter *et al.,* 2000). There is a great difference between bacterial flora of the urine in patients with first attack of urinary tract infection compared to recurrent infections. *Escherichia coli* are the most common organism in acute infection (Nicolle *et al.,* 2008, Ronald, 2002). In recurrent urinary tract infections, especially in the presence of structural defects of urinary tract such as obstructive uropahty, congenital anomalies, neurogenic bladder and fistula, the other organisms such as *Proteus, Pseudomonas, Klebsiella* and *Enterobacter* will also become important. However, in recent years cases resulted from Enterococcus and staphylococcus are also rising. In the presence of structural defects, there is also the possibility to segregate multiple organisms. Because the use of repeated courses of antibiotic therapy is common in these patients, antibiotic resistance in these patients is expected (Gaynes *et al.,* 2005).

Although culturing urine sample and assessing antibiotic resistance can be helpful for proper treatment of urinary tract infections, due to the severe complications of these infections such as severe and irreversible damage to the kidneys which can even cause kidney failure, starting the antibiotic treatment as soon as possible considering the common organisms and antibiotics affecting the organisms available in the area is recommended (Gaynes *et al.*, 2005). In a study that Zaytoun *et al* conducted in America on 1446 patient records who were under the prostate biopsy, 40 patients developed infection after biopsy in which 31 patients have febrile urinary tract infection and 9 cases have nosocomial sepsis. Of the 31 patients, 20 patients (64.5%) had a positive urine culture with *Escherichia coli* that 55% of them were the infection resistant to fluoroquinolone and the remaining were susceptible to fluoroquinolone (Zayton *et al.*, 2011). This study has been conducted with the aim to determine the resistance of bacteria causing the urinary tract infection and factors affecting the antimicrobial resistances (resistant strains) in Qazvin Bu Ali Sina Hospital to suggest reasonable strategies for the treatment of urinary tract infections in this region.

MATERIALS AND METHODS

In this study which is a analytical epidemiological one (case-control cohort), all cases of urinary tract infection with positive cultures in hospitalized patients in general, infectious and ICU sections of Abu Ali Sina Hospital in years 2014 to 2015 were enrolled. Samples without pouria and asymptomatic were excluded due to the high probability of contamination. For all eligible persons, pre-designed questionnaire were completed by trained interviewer. This questionnaire consists of two parts. The first part includes demographic information including age, sex, occupation, place of residence, body Mass Index (BMI), metabolic syndrome, recent travel history, history of staying in nursing homes and the second part consists of information about biography, history of UTI in the past 6 months, complicated infections, sounding history in last year, the history of having or treatment of kidney stones, the ability to perform daily tasks, bedsores, incontinence urine and fecal, fed through a stomach tube, history of cardiovascular disease and diabetes mellitus.

In this study, urine samples were collected from middle part of urine stream and cultured according to standard methods, 0.01 cc was cultured on Blood agar medium and on Mackonky agar medium and both plates were read after 24 hours. The type of bacteria was identified by differential tests. After determining the type of bacteria, antibiogram tests were performed according to nime McFarland and Disk Diffusion Methods. If a strain of Gram-negative bacteria had ESBL criteria, antibiogram was performed by Minimum inhibitory concentration (MIC) method.

Study population and sampling procedure: This study was performed as census in patients referring to general, infectious and ICU sections and had positive urine culture during one year (May 2013 to May 2014). At the end data was statistically analyzed using the software SPSS Version 11.5 (SPSS Inc, Chicago, USA).

RESULTS

A. Antibiotic susceptibility of E. coli

E. coli organisms isolated from patients'samples had the highest sensitivity to Imipenem and Amikacin and 74 cases (98.7%) of these organisms were sensitive to these antibiotics (Fig. 1).

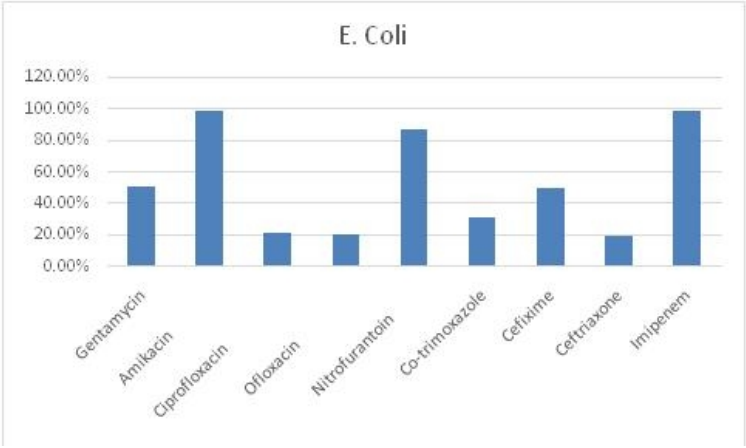

Fig. 1. Sensitivity percent of *E. coli* organism towards different antibiotics.

The rate of susceptibility to other antibiotics were as follows, respectively, complete sensitivity in 58 cases (86.6%) and relative sensitivity in 1 case (1.5%) for Nitrofurantoin, in 38 cases (50.7%) for Gentamycin, 1 case (50%) for Cefexime, 20 cases (31.7%) for Co-trimoxazole, 15 cases (20.8%) for Ofloxacin, 16 cases (21.3%) of complete sensitivity and 2 cases (2.7%) of relative sensitivity to Ciprofloxacin, and 15 cases (20%) for Ceftriaxone. *E. coli* organisms in patients who had a history of antibiotic use (4 of 37 case-insensitive) are insignificant compared to the other patients (11 out of 35 susceptible) were less sensitive to antibiotics Ofloxacin (10.8% vs. 42.3%, P = 0.031, Chi-squared test, OR: 0.264, CI95%: 0.075-0.931).

The *E. coli* organisms in patients who had a history of antibiotic use (case sensitive 3 of 39) are significantly higher than other patients (12 out of 36 susceptible) were less sensitive to antibiotics Ceftriaxone (10.8% vs. 42.3%, P = 0.031, Chi-squared test, OR: 0.166, CI95%: 0.042-0.653).

Organisms isolated from *E. coli* cultures in patients with complicated urinary tract infections (7 of 55 case-insensitive) are insignificant compared to the other patient (case sensitive 8 of 20) were less sensitive.

DISCUSSION AND CONCLUSION

Samples of *Escherichia coli*, as the most common obtained organism, had the greatest sensitivity to the Imipenem and Amikacin and 74 cases (98.7%) of these organisms were sensitive to these antibiotics. The rate of susceptibility to other antibiotics were as follows, respectively, complete sensitivity in 58 cases (86.6%) and relative sensitivity in 1 case (1.5%) for Nitrofurantoin, in 38 cases (50.7%) for Gentamycin, 1 case (50%) for Cefexime, 20 cases (31.7%) for Co-trimoxazole, 15 cases (20.8%) for Ofloxacin, 16 cases (21.3%) of complete sensitivity and 2 cases (2.7%) of relative sensitivity to Ciprofloxacin, and 15 cases (20%) for Ceftriaxone. In the case of *E. coli* sensitivity to Ceftriaxone, none of the two variables of complicated urinary tract infection and history of antibiotic use were independent predictors of antibiotic susceptibility (P> 0.05). Seventeen cases (21.9%) of obtained *Escherichia coli* organisms were Extended-spectrum beta-lactamase (ESBL). Also in the case of *Escherichia coli* sensitivity to Co-trimoxazole, none of the two variables of urinary catheter in the last year and indwelling urinary catheter were independent predictors of antibiotic susceptibility (P> 0.05). In the case of *Escherichia coli* sensitivity to Ofloxacin, none of the three variables of having diapers, history of antibiotic use and bedsores were independent predictors of antibiotic susceptibility (P> 0.05). In a study which was done in America by doctor Karlowsky *et al* in 2002 on women suffering from urinary tract infections, the sensitivity rate of *Escherichia coli* organism to Nitrofurantoin was more than 98% (Karlowsky *et al.*, 2002) which is slightly higher than nearly 88.1% rate of the total amount of complete and relative sensitivity to this organism. The antibiotic sensitivity rate is also reported 78.4% in Nepal and 20% in India, which indicates a relatively acceptable and better condition of our patients in terms of resistance to these antibiotics in these countries (Das *et al.*, 2006). *E. coli* organism sensitivity to Imipenem as well as Amikacin in most other studies similar to the present study (98.7%) have been reported very high and close to 100%, however, in a report from India the sensitivity to Amikacin have been reported about 50%. On the other hand, the sensitivity to Ciprofloxacin in most conducted studies is higher than the findings of this study (24%). For example, this rate is equal to 97% in America, 31% in India and 55% in Nepal (Karlowsky *et al.*, 2002). This finding could be due to the excessive use of this antibiotic by patients in the present study, in fact, about one third of patients were reported to have a history of taking this antibiotic in the last six months. The sensitivity of *Escherichia coli* to Co-trimoxazole in the present study (31.7%) is also much lower than the values reported from other countries which is equal to 83% in America, 76% in India, 77% in Nepal, and 60% in Turkish (Akram et al ., 2007). *E. coli* samples obtained from the study population relative sensitivity, Acceptable to several antibiotics commonly used to treat urinary tract infections Ciprofloxacin resistance, but they have a higher than expected.

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