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**ORIGINAL ARTICLE**

# Symptomatic nosocomial urinary tract infection in ICU patients: identification of antimicrobial resistance pattern

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## ABSTRACT

**Background**: Nosocomial infections are generally occurring 72 hours after admittance and are not present or incubating prior to admittance. The most common nosocomial infection is urinary tract infection (UTI). Scanty data are available regarding the nosocomial infections in Iranian teaching hospitals. The aim of the present study was to determine the frequency of symptomatic nosocomial UTI, identify the etiologic organisms, and determine their antimicrobial susceptibility pattern.

**Patients and methods**: This cross sectional study was conducted on ICU patients of Firoozgar hospital affiliated to Iran University of Medical Sciences from September 2003 to September 2005. Antimicrobial susceptibility pattern was achieved by disk-agar diffusion and E. test methods.

**Results**: Totally, 306 patients were admitted to ICU, of whom 28 (9.2%) suffered from symptomatic UTI. The most common isolated organism was Klebsiella (13 cases, 46%) followed by E.coli, Pseudomonas and Enterobacter spp. A high level of resistance was observed for third generation cephalosporins (Pseudomonas 100%, Klebsiella 92%, E.coli 71% and Enterobacter 25%), however, microorganisms were less resistant to imipenem and cefepime.

**Conclusion**: Based on observed results, carbapenems and cefepime are the drugs of choice for empiric antibiotic therapy of nosocomial UTIs in Firoozgar hospital.

**Keywords**: *Nosocomial infection, Urinary tract infection, Antimicrobial susceptibility pattern.*
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## INTRODUCTION

Urinary tract infections (UTIs) are the most common nosocomial infections which account for about 40% of all hospital – acquired infections and constitute a major source for nosocomial septicemia and related mortality in acute care hospitals. The vast majority of UTIs occur in patients with temporary indwelling bladder catheters (1). Indwelling urinary catheters pose a risk for many infective complications such as perinephric, vesical, and urethral abscesses as well as epididymitis, prostatitis and orchitis. The overall incidence of these complications is unknown, although 20 to 30 percent of patients with asymptomatic catheter-induced UTIs may develop local or systemic symptoms (2).

The microorganisms usually responsible for catheter-associated UTIs are derived from the fecal flora native to the patient or originate in the hospital environment. They include E.coli, Enterococcus species, Pseudomonas aeruginosa, Klebsiella pneumonia, Proteus mirabilis and Candida albicans (3).

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It is likely that patterns of microbial infection and antibiotic resistance differ widely from one hospital or country to another. In one study in Karachi, Rizvi and his colleagues determined the pattern of nosocomial infections in two ICUs. E. coli, P.aeruginosa and K. pneumonia were the most common isolated pathogens. E.coli and klebsiella showed a maximum sensitivity to imipenem followed by piperacillin-tazobactam. Pseudomonas was sensitive to amikacin and fosfomycin (4).

Savas and his colleagues studied nosocomial UTI and showed that E.coli and candida were the most common pathogens. The most effective antibiotics against gram-negative bacteria were found to be imipenem and meropenem (5). Danchaivijitr and colleagues who conducted a study on catheter-associated UTI in Bangkok concluded that catheter associated UTI was common and uropathogens were nosocomial microorganisms with high incidence of resistance to antimicrobials agents (6).

Although UTIs are the most common hospital-acquired infections, the epidemiology of these infections is not well defined in Iran. The objectives of this study were to determine the frequency of symptomatic nosocomial UTI in ICU patients, identifying the etiologic microorganisms and investigate antimicrobial resistance among the patients consecutively admitted to the adult ICU of Firoozgar hospital in Tehran during a 2-year period.

## PATIENTS and METHODS

For this cross sectional study, cases of symptomatic nosocomial UTI admitted to the ICU of Firoozgar hospital in Tehran were included. The study was carried out between September 2003 and 2005. Symptomatic UTI was defined based on guidelines proposed by CDC. A symptomatic UTI must meet at least one of the following criteria:

1- Patients must have at least one of the following signs or symptoms with no other recognized cause: fever (>38°c), urgency, frequency, dysuria, or suprapubic tenderness, along with a positive urine culture, i.e. $\geq 10^5$ microorganisms per $cm^3$ of urine with no more than two species of microorganisms.

2- Patients must have at least two of the following signs or symptoms with no other recognized cause: fever (>38°c), urgency, frequency, dysuria, or suprapubic tenderness, and at least one of the following:

* Pyuria (urine specimen with $\geq 10$ WBC/$mm^3$)

* At least two urine cultures with repeated isolation of the same uropathogen (gram-negative bacteria or S.saprophyticus with $\geq 10^2$ colonies/ml in nonvoided specimens).

The following initial data were also recorded: patients' age, gender, presence and duration of urinary catheter, type of isolated organisms and their antimicrobial susceptibility pattern.

For each causative pathogen, antibiotic susceptibility was routinely determined by disk-agar diffusion (Antimicrobial Susceptibility TEST DISCS, PADTAN TEB, Tehran, Iran) and E. test methods (ceftriaxone, cefotaxime, ceftazidime, amikacin, ciprofloxacin, imipenem, and cefepime).

The Mueller Hinton Agar was used as the growth medium and the antibiogram determination was performed on positive culture. Susceptibility testing was performed by E. test (AB Biodisk, Solna, Sweden) in accordance with the manufacture's instructions.

Quality control was assured by concurrent testing with the American Type Culture Collection (ATCC) strains. After the incubation in the ambient air, MIC was interpreted as the point at which the inhibition ellipse intersected with the E. test strip edge. The testing procedures were validated in accordance with the guidelines of the National Committee for Clinical Laboratory Standards (NCCLS 2003).

Data were analyzed using SPSS software (version 11.5, SPSS Inc., USA) and chi square and t-test were used, when appropriate.

## RESULTS

During the study period, a total of 306 patients were admitted to the ICU, of whom 138 (45.1%) were female and 168 (54.9%) were male.

Based on CDC guidelines, 28 patients (9.15%), including 7 females and 21 males suffered from symptomatic UTI. The mean age of patients (±SD) was 51.9 (±17.7) years. All of these patients had urinary catheter. The average length of hospitalization during which UTI developed was 9.96±8.84 days.

The most commonly isolated organism was Klebsiella (13 cases, 46%) followed by E.coli (7 cases, 25%), Pseudomonas (4 cases, 14%) and Enterobacter spp. (4 cases, 14%).

Antimicrobial susceptibility patterns of pathogens determined by disk diffusion and E. test methods are shown in table 1 and 2, respectively.

**Table 1**. Antimicrobial resistance pattern of microorganisms by disk-agar diffusion method*

| | Pathogen | | | |
|---|---|---|---|---|
| **Antibiotic** | **Klebsiella (n=13)** | **E.coli (n=7)** | **Pseudomonase (n=4)** | **Enterobacter (n=4)** |
| **Imipenem** | 31 | 0 | 25 | 0 |
| **Cefepime** | 31 | 0 | 25 | 0 |
| **Ceftriaxone** | 92 | 71 | 100 | 25 |
| **Ceftazidime** | 92 | 71 | 100 | 25 |
| **Cefotaxime** | 92 | 71 | 100 | 25 |
| **Amikacin** | 43 | 28 | 50 | 0 |
| **Ciprofloxacin** | 70 | 43 | 50 | 25 |

* Results are presented in percentage

**Table 2**. Antimicrobial resistance pattern of microorganisms by E. test*

| | Pathogen | | | |
|---|---|---|---|---|
| **Antibiotic** | **Klebsiella (n=13)** | **E.coli (n=7)** | **Pseudomonase (n=4)** | **Enterobacter (n=4)** |
| **Imipenem** | 23 | 0 | 0 | 0 |
| **Cefepime** | 23 | 0 | 25 | 0 |
| **Ceftriaxone** | 92 | 71 | 100 | 25 |
| **Ceftazidime** | 92 | 71 | 100 | 25 |
| **Cefotaxime** | 92 | 57 | 100 | 25 |
| **Amikacin** | 46 | 28 | 75 | 25 |
| **Ciprofloxacin** | 70 | 43 | 50 | 25 |

* Results are presented in percentage

## DISCUSSION

The indication of antibiotic therapy for nosocomial UTIs in acute care settings is a controversial issue. Nonetheless, the treatment of symptomatic UTIs is virtually universal. Yet routine therapy increases not only drug costs but also adverse drug reactions and the emergence of antibiotic–resistant microorganisms. Therefore, we have to increase our knowledge about patterns of antimicrobial susceptibility of pathogens in each hospital.

In the present study, among 306 ICU patients 28 (9.15%) suffered from symptomatic UTI. Parlak and his colleagues reported that the frequency of nosocomial UTI in ICU was 39.1% while no patients had developed symptoms (7). Askarian and his colleagues reported that catheter-associated UTI rate in a burn center in Shiraz, Iran, was 30 per 1000 urinary catheter days (8). The lower rate of UTI in our study is probably due to the protocol of study since we only included symptomatic UTI. The study of Wagenlehner et al showed that 28% of the nosocomial infections were UTIs and the rates of catheter-associated UTIs varied between 4.2 (symptomatic UTI) and 14 (asymptomatic UTI) (9).

Interestingly, our finding revealed that 75% of the patients with nosocomial UTI were men, however, in other studies UTI was more common among women (10,11). Gales reported 65.6% of the patients with UTI were women (11).

The mean age of our patients (51.9±17.7 years) was in accordance with Parlak and Gales studies (7,11).

In our study, the average length of hospitalization during which symptomatic UTI developed was 9.96 days. Parlaks' study showed all nosocomial UTIs had developed in patients with urinary catheters and infections had occurred in 72.2% of the patients with catheters lasting for 7 days (7).

All of our patients used indwelling catheter, a device which is thought to be the most significant risk factor for developing nosocomial UTI. Thus, the selection of patients for whom catheterization is useful should be made carefully and the catheter must be removed in time (12,13).

In our study, Klebsiella was the most common pathogen, followed by E.coli, Pseudomonas, and Enterobacter. Prior studies reported different etiologies. Bochicchio and his colleagues showed E.coli, Enterococcus sp. and Candida sp. were the most common pathogens isolated in critically ill trauma patients (14). Another study demonstrated similar findings (15). Rizvi carried out his study in two ICUs and showed E. coli as the most common pathogen followed by Pseudomonas and Klebsiella (4).

Worldwide surveillance of antimicrobial resistance among urinary tract pathogens is useful to determine important trends and geographical variation for common gram- positive and -negative species. In our results a high level of resistance was observed for third generation cephalosporins (Pseudomonas 100%, Klebsiella 92%, E.coli 71% and Enterobacter 25%). A low level of resistance was observed for amikacin, gentamicin and quinolones among the Enterobacter. In one study on nosocomial UTI in Nepal, the most commonly isolated pathogens were E.coli, Klebsiella, and Enterococcus faecalis, for which higher susceptibilities were seen for amikacin (87.2%), ciprofloxacin (74.8%), ceftazidime (71.5%), and gentamicin (70.4%), however, the following were less susceptible for nitrofurantoin (35%), cephalexin (49.7%), and ampicillin (50.5%). E.coli was found to be most susceptible to amikacin followed by gentamicin, ceftazidime, norfloxacin, and co-trimoxazole (16). Irrational uses of quinolones and third generation cephalosporins have resulted in increasing incidence of resistance to these antibiotics, even in community-acquired infections. In a study on patients with UTI by Akbari-Nakhjavani et al, they determined antimicrobial susceptibility pattern of E.coli from patients with UTI to quinolones by disk-agar diffusion and MIC methods. They showed 49.3% of the isolates were resistant to nalidixic acid and 41.4% to norfloxacin. Using MIC method, 41.2% of the isolates were resistant to ciprofloxacin (17). We found similar results using the two above-mentioned methods except for the susceptibility of E.coli to cefotaxime and pseudomonas and enterobacter to amikacin. Therefore, disk-agar diffusion is a reliable method to evaluate the susceptibility pattern of gram -negative bacilli.

In conclusion, with respect to the low level of resistance to imipenem and cefepime, the best empiric antibiotic therapy for nosocomial UTI in our teaching hospital is carbapenems (imipenem or meropenem) and cefepime. We also emphasize the need for continued surveillance studies on common nosocomial infections which establish baseline resistance patterns in different geographical areas. Prevention through implementation of strict infection control guidelines, effective hand washing and judicious use of antimicrobials such as third generation cephalosporins can reduce the morbidity associated with nosocomial infections.

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