Original Article

Prevalence of Catheter-associated *bacteriuria* in patients who received short-term catheterization in the northeast of Iran

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Received: 13 January, 2018; Accepted: 25 February, 2018

Abstract

Background: Catheter-associated (CA) bacteriuria is a result of the extensive usage of urinary catheterization. Once a catheter is placed, many patients achieve bacteriuria, even with the use of greatest consideration and care of the catheter. In this study, we decided to evaluate the prevalence of Catheter-associated bacteriuria in patients who received short-term catheterization in the northeast of Iran.

Materials and Methods: In this cross-sectional study during one year (among 2014-2015) 275 patients who have admitted recently and have no history of catheterization and drug consumption were included. Three samples were taken from patients before, one day after catheterization and after removal of the catheter. The urine samples were analyzed and cultured on the suitable media. Antibiotics susceptibility testing was performed by disk diffusion method. Then, data analyzed using SPSS software by Student t-test. In addition, the p values less than 0.05 were considered as significant.

Results: In general, the rate of catheter-associated bacteriuria in these hospitals was 68% (187 cases of 275). The mean age of the participants and patients with bacteriuria were 41±1.2 and 24.8±6.2 years old, respectively. The most common isolated bacteria were *Escherichia coli* (50.6%) followed by *Staphylococcus aureus* and *Klebsiella pneumonia* (21.6%). The highest sensitivity was reported against kanamycin (68.9%) and highest resistance was observed against ampicillin with a rate of 96.3%.

Conclusion: For prevention of healthcare-associated UTI, correct catheterization and use of the closed catheter system is recommended. In addition, before prescribing any antibiotics it should be paying attention to the antibiotics susceptibility testing results.

Keywords: Bacteriuria, Catheterization, Hospital, Mashhad, Iran

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Please cite this article as: Khaledi A, Hooshyar Chichaklu A, Piroozmand A, Meskini M, Ghazvini K. Prevalence of Catheter-associated *bacteriuria* in patients who received short-term catheterization in the northeast of Iran. Novel Biomed. 2018; 6(2):79-84.

Introduction

The presence of bacteria in the urinary tract is named bacteriuria. Catheter-associated (CA) urinary tract infection could be very damaging to the patient in the hospital and extensive efforts are made to decrease the occurrence rate of CA infections[1]. Bacteriuria is divided into two categories: symptomatic and asymptomatic.

The presence of bacteria in the urine of a patient without symptoms and signs is known as asymptomatic bacteriuria[2]. The most important risk factor in the development of bacteriuria are; female sex, elderly, inhabitants of long-term care settings, patients who have bladder catheters or diabetes, patients undergoing hemodialysis and patients with spinal cord injury, renal function impairment, poor quality of catheter care in catheter-associated bacteriuria[2]. In patients with application of indwelling catheter, bacteriuria was reported and prevalence of chronic asymptomatic bacteriuria without UTI symptoms is high as 50%[3]. *Escherichia coli* is the most common organism isolated from these patients. Other common bacteria involved in bacteriuria are *Enterobacteriaceae*, *Pseudomonas aeruginosa*, *Enterococcus* species, and group B *streptococcus*[4]. In total, the prevalence of asymptomatic bacteriuria in men and women of community is 3.6-19% and 10.8-16%, respectively[5]. The rate of bacteriuria raises 1-2% per decade in people life, similarly, the percentage of asymptomatic bacteriuria increases with age. Asymptomatic bacteriuria prevalence in postmenopausal women age 50-70 years old is 2.8-8.6%, whereas in younger women this rate is 1-2%.[6] Furthermore, people above the age of 80 years old have a prevalence of 20%[7]. About 7% of patients with catheters get bacteriuria each day, even with the use of greatest preparation for placing and care of the catheter[8]. Usually, most patients with a long duration of the catheter are bacteriuric, frequently with two or more bacteria[9]. Bacteriuria are more dangerous in pregnant women because untreated upper urinary tract infection in pregnancy can increase risks of abortion and morbidity[10]. Approximately 2-9% of pregnant women have bacteriuria in the first- trimester and 10-30% of women with bacteriuria in the first-trimester progress UTI in the next trimesters[11]. Bacterial culture is a gold standard for the diagnosis of bacteriuria[13] of course use of urine microscopy and urine dipstick test for urinary nitrite is useful but conventional[14]. Regarding the importance of catheter-associated bacteriuria as one of the most common infections in the hospital, in this study, we decided to evaluate catheter-associated bacteriuria in Imam Reza and Ghaem university hospitals, Mashhad, Iran.

Methods

Selecting the patients: Because the main purpose of this study was to determine the occurrence of bacteriuria and identification of microorganisms causing bacteriuria in our hospitals, we've chosen pregnant women for our study with no history of catheterization and drug consumption in the past few months. Pregnant women were chosen because they were the candidate for cesarean and subsequent short term catheterization with no history of previous infection or medication.

Samples collection methods: In this cross-sectional study during one year (Between 2014 and 2015) 275 patients were included in present study. Three samples were taken from each patient (the first sample before inserting the catheter, the second sample one day after the establishment of the catheter and the third sample after removal of the catheter). The investigation was performed on 275 participants who were mostly admitted for cesarean section and sometimes hysterectomy**.** We categorized the patients in three age groups; 20-29 (age group 1), 30-39 (age group 2), 40-49 (age group 3) and 50-59 (age group4). In terms of income; patients divided into three groups; poor (group 1), average (group 2) and high (group 3), respectively.

In this study, the third sampling of 18 individuals was missed because of early discharge**,** and 16 others due to the first or second positive samples were excluded from our study. The first sample was taken to determine whether the patient had an infection before catheterization or not. The second and third samples were taken (after 24 and 72 h of catheterization) to determine how catheterization can cause bacteriuria. The catheter had remained in patients' bladder for 12 to 24 h in 95% of patients, only 5% of patients had the catheter for longer periods. The first and third samples (midstream) were taken by the patients under sterile conditions. Subsequently, samples have transferred to the laboratories of Imam Reza and Ghaem university hospital for bacteriuria detection and identification. The samples were cultured on MacConkey agar and sheep blood agar. After 24 h incubation at 37°C with the appearance of colonies on the plate, gram stain, microbial and biochemical tests were performed to identify bacterial isolates. Also, necessary information was obtained from the patients.

Susceptibility testing using disk diffusion method: As has already been mentioned susceptibility testing was accomplished by disk diffusion method (Kirby-Bauer)[12] on the isolates in agreement with the standards of CLSI 2014. [13] The accuracy of antibiotic disks was verified by standard strains of *E. coli* with ATCC 25922. Antibiotic disks used in this study are comprised of; Cefuroxime (CF), Sulfamethoxazole-Trimethoprim (SMZ or SMX), Nalidixic acid(NA), Ampicillin(Am), Cephalothin, Gentamicin, Kanamycin(K), Streptomycin(S), Tetracycline(Te), Chloramphenicol (C), Ampicillin(Amp), Carbenicillin(CB), Nitrofurantoin(F/M), Penicillin(p) and Erythromycin(E), (Company MAST).

Microscopic examination of urine sediment: The sediment of samples was examined by the light microscope. For this purpose, 10 ml of urine was centrifuged, then the supernatant was discarded and urine sediment was examined for the presence of cylinders and urinary tract cells.

Ethical considerations: Because the study had a laboratory base did not require specific ethical considerations, however, all patients' rights are respected, such as the non-disclosure of their names.

Statistical analysis: Data analyzed using SPSS software by Student t-test. In addition, the p values less than 0.05 were considered as significant.

Results

Bacteriuria rate in Imam Reza hospital was 64.8% (96 cases of 148 samples), but in Ghaem hospital, this rate was 71.6% (91 cases of 127 samples). In general, the rate of bacteriuria in both hospitals was 68% (187 cases of 275). The most common bacterium isolated in two mentioned hospitals was *E. coli* with prevalence of 48.2%, where prevalence it in Imam Reza and Ghaem hospitals were 54.5% and 42%, respectively. The second most prevalent bacteria in Imam Reza and Ghaem hospitals were *Staphylococcus aureus* and *Klebsiella pneumonia* with the prevalence 23.6% and 24.5%, respectively.

The mean age of the participants was 41±1.2 years old. The many of the patients (n=119) were in the age group 20-29 years which a high percentage of patients with bacteriuria were also related to the same

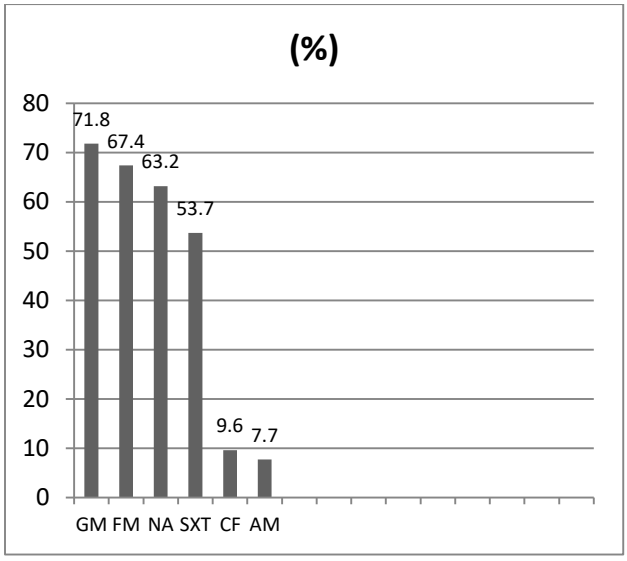

Figure1. The pattern of antibiotic susceptibility in bacterial isolates recovered from patients with UTI.

group. The highest percentage of bacteriuria (90.9%) was reported in this age group. The lowest percentage of bacteriuria (42.9%) was in age group 50-59-year-old. The prevalence of bacteriuria in age group 40-49 years was 44.3%. And also age group 30-39 had the bacteriuria with prevalence about 56%. The mean age of the patients with bacteriuria was 24.8±6.2 years old and significant correlation between age and bacteriuria was not found (p=0.11). Mean weight of patients was 56 kg and most patients (61.5%) were below this average weight and significant correlation between weight and bacteriuria was not seen. But in terms of income; 14%, 39.5% and 46.3% of patients had high, average and poor income, respectively. Of group 1, 60% patients suffered from bacteriuria, and from group 2, 68.4% patients had bacteriuria and finally, 72.3% of individuals in group 3 had bacteriuria that significant difference between bacteriuria and income statue was not seen (p=0.01). Among participants without bacteriuria, 54.5% were didn't have a history of the previous disease and 45.5% had a history of diseases such as; hypertension and heart disease. Among patients with bacteriuria, 71.7% didn't show a history of previous disease, but 28.3% had mentioned a history of diseases; in general, the relationship between bacteriuria and history of previous diseases was not established(p>0.05).

Statistical results from analysis of urine: Third-urine of all patients was examined by light microscopy and various cell types were observed that we considered white blood cells and bacteria. White blood cells (WBC) in patients were divided into 5 groups. The first group (0-4 WBC), group II (5-9 WBC), group III (10-14 WBC), group IV (15-20 WBC) and group V (many WBC). In the patients without bacteriuria, 77.3% were in group1, and in patients with bacteriuria, the most frequency was related to the group 1 with prevalence 63.6%. Also, only 1% was laid in group 4. The results not have shown an increase in the number of white blood cells after catheterization in patients. In third urine samples of two people of patients were seen fungi. To report the number of bacteria in patients; grouping was done as follows: The group 1 (without bacteria), group II (+), group III (++) and group IV (+++). Based this grouping, among patients with bacteriuria, 71.7% and 4% were put in group 2 and 4, respectively.

The results of susceptibility testing: Figure 1 outlines the results of susceptibility testing. The highest susceptibility was obtained to the Gentamicin (71.8%) and the maximum resistance was observed against Ampicillin with rate 92.3%.

Discussion

Catheter-acquired urinary tract infection is considered as one of the most common healthcare-acquired infections in hospitals[14]. The main aim of infection prevention and control programs is the prevention of infections transmission from these devices[15]. In the presence of a catheter, the bacteriuria rate increases by 3-7%. In women and older people, the prevalence rate of bacteriuria is higher[1]. Like this mentioned fact our findings showed that the prevalence rate of bacteriuria in the age group 50-59 years old was higher. About 60–80% of admitted individuals with an indwelling catheter usually receive antimicrobials drugs[16]. This intense antimicrobial exposure causes the emergence of antibacterial resistant organisms from the urine of catheterized patients[17]. Bacteria which colonize the drainage bags of catheterized patients are sources for occurrences of resistant bacteria in acute care unit[18]. CA-UTI (Catheter-Associated-Urinary Tract Infection) is the most dominant opposing result related to resident urinary catheter usage, though merely a small amount of acute care facility inhabitants with CA-ASB (catheter-associated- asymptomatic bacteriuria) improve symptomatic infection[19]. In the European countries has reported that 1.3% of patients had UTI; demonstrating 17.2% of all nosocomial infections and the third most common infection[14]. The frequency of resistance to antibiotics isolated from nosocomial infections is varied among different bacterial species and clinical settings[20]. As shown in our study, the prevalence of catheter-associated bacteriuria was 69.2%, in contrast with our results, in a study conducted by Mojtahedzadeh et al; the UTI rate was 28 (28%). In another study, Leone et al., reported 12% occurrence of catheter-associated UTI (CAUTI) among ICU patients,[21] which this difference referred to the health care settings and types of clinical samples. According to another study differences in the incidence of bacteriuria backed to the selection method, describing various treatment regime in different health medical centers, selecting patients with symptomatic UTI and diversity in cultural and social features of each community[22]. In addition, the higher incidence observed in our study may be due to the difference in the definition of bacteriuria where we considered 10^4 CFU/ml density of isolate also as catheter-associated bacteriuria; this factor was not included in the latter study or may be due in part to the difference in the study population. The most common organism isolated of urine samples was *E. coli* with prevalence 48.2%, but in studies conducted by Mojtahedzadeh et al.[23], and Alebiosu and et al.[24], the most prevalent bacterium was the *K. pneumonia* with the frequency 42.8%. Amiri et al., in a study with the title; the prevalence of urinary tract infection among pregnant women in hospitals of Dezful city, in 2012 – 2013, they reported *E. coli* and *Klebsiella* species with prevalence 57.25% and 20.85% as the most dominant bacteria, respectively.[22] In a similar study conducted by Sohrevardi and et al[25], in Kerman in 2013 was not found a correlation between gender and catheter-associated bacteriuria, based on the male to female ratio, no significant correlation was found between the bacteriuric and non-bacteriuric patients. Our results consistent with the previous study carried out by Mojtahedzadeh et al, in which they were not found any relationship between risk factors stated with bacteriuria. Like our study, most researchers have reported *E. coli* as the most predominant bacterium.[26-

[28] Although age is considered as a prominent risk factor for bacteriuria in women studied,[29] but the age had no significant association with bacteriuria in our study (p=0.00). Like our study, Boroumand and et al. in Tehran in 2006 was not found a correlation between age and ASB in the women had the bacteriuria with the underlying disease of diabetes[30]. In a study carried out in Kerman (Iran), in 2013, 67% of patient with bacteriuria had a history of previous diseases which was in contradiction with our results because this rate in present study only was 28.3%, and the same study in line to our study has reported *E. coli* as the leading agent in patient with bacteriuria (72%) and has been observed the highest susceptibility to gentamicin which this result consistent to our study where susceptibility rate to Gentamicin was 71.8% (85.5%, 82.5% and 47.6% of *E. coli*, *Kelebsiella* and *Staphylococcus* isolates were susceptible to Gentamicin, respectively), therefore regard to the low cost and its availability of this antibiotic is a good choice in treatment of most common bacteria isolated from patients with bacteriuria. As well as the maximum resistance was detected against ampicillin with the prevalence of 92.3%. These results showed that the ampicillin not only is effective antibiotic in the treatment of these patients, even can cause developing of resistant strains. Another study from Iran has reported the *E. coli* (63%) as a most frequent cause of UTI and susceptibility to nitrofurantoin was about 69%, about 37% to gentamicin and 38% to trimethoprim/sulfamethoxazole[31]. The results of antibiotic susceptibility in this study are accordance with the results of our work in the susceptibility of *E. coli* to nitrofurantoin, in which the sensitivity of *E. coli* to nitrofurantoin in the present study was 81.6%. Kalantar Enayat and et al., in Sanandaj, in 2008 accounted *E. coli* as the most prevalent organism and in contrast to a recent study, 73.4% and 79.7% of *E. coli* isolates were resistant to nalidixic acid and cotrimoxazole, respectively. In view of changing pattern of bacterial resistance to conventional antibiotics, physicians must be trained to understand this note that the empirical use of antibiotics is very important.

Conclusion

In conclusion, for prevention of healthcare-associated UTI, correct catheterization and use of the closed catheter system is recommended. In addition, before prescribing any antibiotics it should be paying attention to the antibiotics susceptibility testing results.

Acknowledgment

We would like thank the personnel of medical laboratories of Imam Reza and Ghaem hospitals for help in collecting the clinical specimens. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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