Original Article

Prevalence and antimicrobial susceptibility pattern of isolated microorganisms from central venous catheters in ICU patients

Farzin Khorvash, Saeed Abbasi[1], Mohsen Meidani[2], Mehrnoosh Shakeri[3]

Nosocomial Infection Research Center,[1]Department of Anesthesiology, [2]Infectious Diseases and Tropical Medicine Research Center, [3]Medical Student, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran

Abstract

Background: The abundance of infections associated with intensive care unit (ICU) is increasing due to the increased use of aggressive medical equipments like the central venous catheter (CVC). This study was designed and performed in 2010-2011 at Alzahra hospital, which is a referral center. This study aimed at determining the relative abundance and microbial sensitivity of organisms, which were creating contamination with CVCs in hospitalized patients in the ICUs of Alzahra hospital.

Materials and Methods: This is a cross-sectional study performed on 71 patients who were hospitalized in the Alzahra hospital ICU and had CVCs during 2010-2011. The data obtained was analyzed by SPSS version 20 software and descriptive statistical approaches and chi-square and *t*-test trials.

Results: In the sample culture obtained from the patients' catheter in 19 cases (26/8%), no microorganism was grown and in 52 cases (73.3%) at least one type of microorganism including bacteria or fungus was grown. In this study, average hospitalization time in patients who got positive results from their catheter culture was significantly more compared with patients who did not grow any kinds of microorganism in their sample cultures.

Conclusion: In this study, CVCs microbial contamination has a high prevalence, which is a major cause of prolonged patients staying in ICUs, and therefore, it is essential to take precaution and discharge the patient early for decreasing the catheter contamination and preventing the hospital infections incidence in the ICU patients.

Key Words: Catheter-related infections, central venous catheterization, hospital infection, microbial sensitivity test

Address for correspondence:
Dr. Mohsen Meidani, Department of Infectious Diseases, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran.
E-mail: meidani@med.mui.ac.ir
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INTRODUCTION

Nowadays, one of the important causes of mortality and morbidity is hospital-acquired infections[1,2] and one of the more prevalent places for these infections is the intensive care unit (ICU).[3] Incidence of ICU-acquired infections is 5-10 times more than acquired infections in the general units.[4] A possible explanation for this difference is the need of patients to

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the medical aggressive devices like urinary catheters, arterial catheters, and tracheal tubes that endangers mucosal and skinny barriers.[5] Approximately 150 millions catheters are used in hospitals and in American clinics in a year and more than 5 millions of them are the central venous catheters (CVC).[6] CVC cause different complications, which include thrombosis and bleeding.[7,8] CVCs remain for a longer time in the vein and the frequent use increases the risk of infection.[9] Studies recommended that 20-30% of the acquired infections in hospitals are related to the use of CVCs.[10,11] CVC infections can occur in different ways: Colonization of the catheter by skin flora, local infection of the intradermal portion of the catheter site, and contamination hub or infusion set.[12] Definitions for the infection of blood flow related to the CVCs include infection of the primary blood circulation in 48 hours after entering the CVC.[13] CVC contamination causes an increase in hospitalization costs, morbidity, mortality, and duration of hospitalization; thus prevention of these infections can be effective in reducing this outcomes.[14] Studies have found that colonization in the CVCs or prevalence of contamination increased from 3.8% to 4.7% and prevalence of infections related to catheter increased from 2.5% to 25%.[15,16] The most prevalent pathogens separated from bacteremia with intravenous devices are coagulase negative Staphylococci, *Staphylococcus aureus*, entrococci, Gram negative bacilli, and candida.[17] According to the Center for Disease Control and Prevention guideline (CDC guideline), CVC infection in patients that have CVC was diagnosed according to at least one of the following criteria: (i) Patient has a recognized pathogen cultured from one or more blood cultures that this pathogen is not related to an infection at another site. (ii) Patient has fever, chills, or hypotension.[18] Among all the nosocomial infections, CVC infections are preventable. Several steps can be taken to control these infections: Educational programs for persons who insert the catheters and the maintenance of these, precaution during catheterization (such as gan, glove, mask), use of chlorhexidine as a skin aseptic agent, before catheterization and making sure to take out unused catheters.[19] By doing these simple procedures, we can reduce the incidence of the mortality and morbidity, hospitalization costs, duration of hospitalization stay, and use of antibiotics.

Since the evaluation of the infection frequency is necessary for correct diagnosis and appropriate treatment, we, therefore, decided to investigate the prevalence and antimicrobial susceptibility pattern of the isolated microorganisms from the CVC in ICU patients.

MATERIALS AND METHODS

The present study is an analytical and descriptive study performed on 71 patients who were hospitalized in the ICU of Alzahra hospital and had CVCs during 2010-2011. Inclusion criteria to participate in this study were: Patients aged over 18 years who were hospitalized in the ICU and who have CVC and are hospitalized at least for 48 hours. Sampling was done easily somehow for all the patients hospitalized in the ICU who have CVCs. Accordingly, 71 patients were selected. Approval form of the patients who entered this study was filled out by their family members, their CVC was taken out after completion of the treatment or due to contamination of the catheter. In these patients while discharging the catheter, its tip was cultured on taiogliconate, eosine methylene blue (EMB), and blood agar. Chocolate agar mediums and in the case of bacteria growing, its microbial sensitivity was determined by using antibiotic discs. Information were incorporated in a certain form, which was prepared for these purpose beside other information such as: Age, sex, territorial disease, duration of catheterization, and duration of hospitalization were collected and were written in a mentioned form. Obtained data was analyzed by SPSS version 20 software and descriptive statistical approaches and chi-square and *t*-test trials.

RESULTS

In this study, 71 patients, 38 (53.5%) male and 33 (46.5%) female, with CVCs were investigated. The average age of these patients was 48.6 ± 20.7 years with age range of 18-88 years. There was no significant differences between the sexes ($P = 0.06$) according to the *t*-test.

On average, patients were hospitalized for 49.9 ± 31.1 days with a range of 7-146 days. In addition, average duration of catheterization in these patients was 33.4 ± 24.3 days with a range of 2-116 days.

Location of the catheter in 34 patients (47.9%) was the jugular vein, in 27 patients (38%) it was the subclavian vein, and in 10 patients (14.1) it was the femoral vein.

In the culture sample from the patient's catheter, 73.3% cases had at least one kind of bacteria or fungus that grew in the culture media. Figure 1 shows the percentage of plentifulness of bacteria grown in the culture medium.

Average duration of hospitalization in the patients who grew microorganism in their sample was 55.3 ± 32.5 days and for patients without any growth of microorganisms was 35 ± 21.4 days and according to the *t*-test, difference between the two groups was significant ($P = 0.014$).

Furthermore, average duration of catheterization in these two groups was 35.9 ± 25.6 days and 26.3 ± 18.8 days, respectively, difference between the two groups was not significant (P = 0.14). In addition, place of catheter base on the Fisher test did not have any effects on the growth of bacteria (P = 0.58); the age of patient did not have any effects on growth of microorganisms (P = 0.093). The results are shown in Table 1. Study of antibiotic sensitivity and resistance pattern of grown microorganisms in the culture media is shown in Table 2.

DISCUSSION

This study aimed at determining the relative abundance and microbial sensitivity of organisms, which were creating contamination with CVCs in hospitalized patients in the ICUs of Alzahra hospital during 2010-2011. In this study, 71 patients who had CVCs with an average age of 48.6 ± 20.7 years were studied. Studies and investigations have shown that the long usage of medical aggressive devices like vein catheters increase the risk of infection in the hospitalized patient in the ICU. Furthermore, duration of hospitalization and duration of catheterization are two determinant agents in incidence of hospitalized infection.[20] Thus these patients, because of long hospitalization and long time of catheterization, are candidates for affliction to infection.

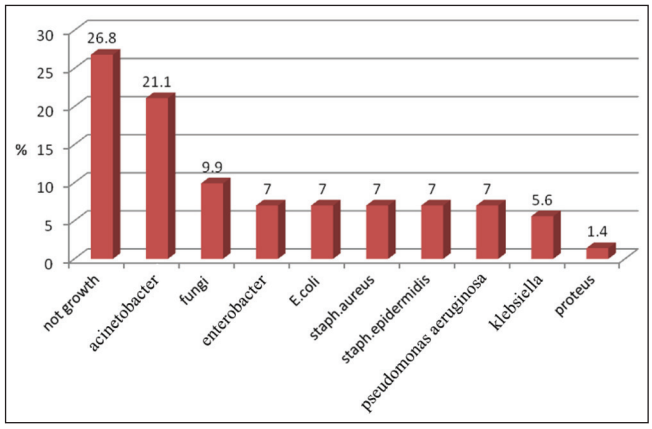

Figure 1: Percentage of type of microorganisms in culture media

Table 1: Distribution of term of variants on the base of microorganism growth

Variables	No. (%) of microorganisms growth		*P*-value
	Yes	No	
Duration of hospitalization (days, mean±SD)	55.3±32.5	35±21.4	0.014
Duration of catheterization (days, mean±SD)	35.9±25.6	26.3±18.8	0.14
Location of catheter			
Jugular	9 (47.4)	25 (48.1)	0.58
Subclavian	6 (31.6)	21 (40.4)	
Femoral	4 (21.1)	6 (11.5)	
Sex			
Male	10 (52.6)	28 (53.8)	0.93
Female	9 (47.4)	14 (46.2)	

According to this study results, in the culture sample from the patient's catheter, 73.3% cases had at least one kind of bacteria or fungus that grew in the culture media. The catheter can be an important agent for affliction to the hospitalized infections. Sharif *et al.*, in a study at the medical university of Kashan, showed that from the 100 samples that were cultured from the patients' catheter, 29% cases had at least one kind of microorganism including bacteria or fungus that grew in the culture media, which is less than the prevalence of infection in this study. In this study, the most grown bacteria was Acinetobacter, whereas in the Sharifs study, the most grown bacteria was coagulase negative Staphylococcus.[21] In another study by Shirazi *et al.* in a medical university, from the 300 catheter samples, microbial infection was seen in 17% of the samples and the most grown bacteria incultured media was Staphylococcus epidermis.[22]

In a study done in Brazil by Grothe *et al.,* out of the 156 inpatients, 94 catheter samples' culture was positive (60%).[23] Also in this study, patients whose catheters were put in the jugular vein, 56% more than patients that their catheters were put in to subclavian vein, suffered from the CVC infection, whereas in this study, location of the catheter did not have any effects on getting positive results from the cultures.

In another study done by Andrew *et al.,* incidence of the catheter infection has been reported as 4.3% patients instead of 1000 patients that were admitted in ICU.[24] In a study done in Brazil by Eni Rosa *et al.,* out of the 630 patients who had CVC 6.4% of patients suffered from CVC infection.[25] One of the reason for a high level of contamination in our patients was probably related to the longer time of hospitalization. In this study, variable cases included: Age, sex, location of catheter, duration of catheterization, and duration of hospitalization. Average hospitalization time in patients who got positive results from their catheter culture samples was significantly more compared with patients who did not grow any kinds of microbes in their sample culture; but growth of microorganisms and positive results of culture did not have significant relation with age, sex, location of catheter, and duration of catheterization. Thus care of the catheter, in the patients who are hospitalized in the ICU, is one of the requisite tasks, hygienic care of these patients must be increased, patients must be discharged early, and reduce the duration of hospitalization; all these factors can reduce the incidence of CVC-related infection.

Table 2: Sensitivity and resistance pattern of grown microorganism in culture media

Antibiotics	Isolated Organisms																	
	S. aureus		S. epidermidis		E. coli		Entrobacter		Klebsiella		Proteus		Acinetobacter		P.aeruginosa		Fungi	
	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R
Oxacillin	-	4	-	5	-	-	-	1	-	-	-	-	-	6	-	-	-	-
Ampicillin	-	4	-	5	2	3	1	4	-	4	-	1	-	13	-	4	-	-
Tazocin	-	-	-	-	-	-	1	3	4	-	1	-	-	11	3	-	-	-
Ceftazidime	-	-	-	-	2	3	-	4	-	4	-	-	-	10	-	5	-	-
Cefotaxime	-	-	-	-	2	-	-	1	-	1	-	1	-	7	-	1	-	-
Cefepime	-	-	-	-	-	-	-	3	1	3	-	1	-	10	-	1	-	-
Imipenem	-	-	-	-	4	-	2	-	3	-	-	-	-	9	5	-	-	-
Meropenem	-	-	-	-	1	-	-	-	1	-	-	-	1	3	-	-	-	-
Vancomycin	5	-	5	-	-	-	1	1	-	-	-	-	3	4	-	-	-	-
Gentamicin	-	-	-	-	-	-	-	1	-	-	-	-	-	3	-	-	-	-
Amikacin	-	-	-	-	4	-	1	2	1	3	-	1	-	11	-	1	-	-
Tetracycline	-	4	1	3	-	-	-	2	-	-	-	-	-	6	-	-	-	-
Ciprofloxacin	-	4	-	2	-	2	1	4	-	1	-	1	1	12	3	-	-	-
Cotrimoxazole	3	-	-	2	2	-	-	2	-	-	-	-	4	4	-	-	-	-
Clindamycin	2	3	-	2	-	-	-	2	-	-	-	-	1	6	-	-	-	-
Nitrofurantoin	-	-	-	-	1	-	-	-	-	-	-	1	-	3	-	-	-	-

S: Sensitivity, R: Resistance

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