

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

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## 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

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## INTRODUCTION

Nowadays, one of the important causes of mortality and morbidity is hospital-acquired infections<sup>[1,2]</sup> and one of the more prevalent places for these infections is the intensive care unit (ICU).<sup>[3]</sup> Incidence of ICU-acquired infections is 5-10 times more than acquired infections in the general units.<sup>[4]</sup> 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.<sup>[5]</sup> 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).<sup>[6]</sup> CVC cause different complications, which include thrombosis and bleeding.<sup>[7,8]</sup> CVCs remain for a longer time in the vein and the frequent use increases the risk of infection.<sup>[9]</sup> Studies recommended that 20-30% of the acquired infections in hospitals are related to the use of CVCs.<sup>[10,11]</sup> 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.<sup>[12]</sup> 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.<sup>[13]</sup> 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.<sup>[14]</sup> 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%.<sup>[15,16]</sup> The most prevalent pathogens separated from bacteremia with intravenous devices are coagulase negative Staphylococci, *Staphylococcus aureus*, enterococci, Gram negative bacilli, and candida.<sup>[17]</sup> 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.<sup>[18]</sup> 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.<sup>[19]</sup> 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  $48.6 \pm 20.7$  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  $49.9 \pm 31.1$  days with a range of 7-146 days. In addition, average duration of catheterization in these patients was  $33.4 \pm 24.3$  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  $55.3 \pm 32.5$  days and for patients without any growth of microorganisms was  $35 \pm 21.4$  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  $35.9 \pm 25.6$  days and  $26.3 \pm 18.8$  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  $48.6 \pm 20.7$  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.<sup>[20]</sup> Thus these patients, because of long hospitalization and long time of catheterization, are candidates for affliction to infection.

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*.<sup>[21]</sup> 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*.<sup>[22]</sup>

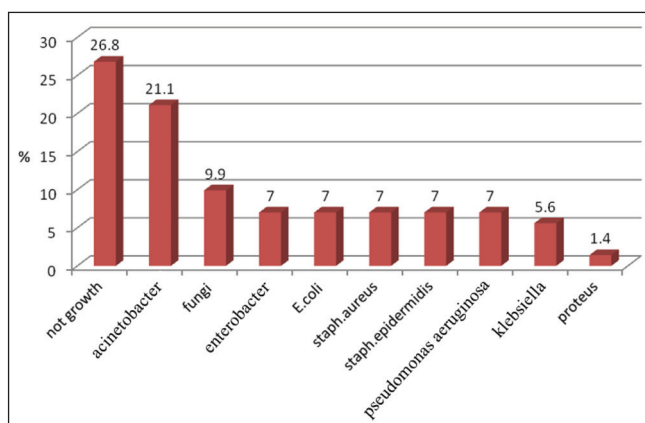


Figure 1: Percentage of type of microorganisms in culture media

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)	

In a study done in Brazil by Grothe *et al.*, out of the 156 inpatients, 94 catheter samples' culture was positive (60%).<sup>[23]</sup> 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.<sup>[24]</sup> 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.<sup>[25]</sup> 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

**REFERENCES**

- Emmerson AM, Enstone JE, Griffin M, Kelsey MC, Smyth ET. The second national prevalence survey of infection in hospital-overview of the results. *J Hosp Infect* 2006;32:175-90.
- Weinstein RA. Nosocomial infection update. *Emerg Infect Dis* 1998;4:416-20.
- Donowitz LG, Marsik FJ, Fisher KA, Wenzel RP. High risk of hospital-acquired infection in the ICU patient. *Crit Care Med* 1982;10:355-7.
- Yehia N, Al-Mousa HH, Al-Asar ES. Nosocomial infection in a medical-surgical intensive care unit. *Med Prink Pract*2008;17:373-7.
- Vincent JL, Bihari DJ, Suter PM, Bruinig HA, White J, Nicholas Chanoin MH, *et al.* The prevalence of Nosocomial infection intensive care unit in Europe. Results of The European prevalence of infection in intensive care study. EPIC International advisory committee. *JAMA* 1995;274:639-44.
- McGee DC, Gould MK. Preventing complications of central venous catheterization. *N Engl J Med* 2003;348:1123-33.
- Spengler RF, Greenough WB. Hospital costs and mortality attributed to nosocomial bacteremias. *JAMA* 1978;240:2455-8.
- Collignon PJ. Intravascular catheter associated sepsis: A common problem. The Australian Study on Intravascular Catheter Associated Sepsis. *Med J Aust* 1994;161:374-8.
- Centers for Disease Control and Prevention. National Nosocomial Infections Surveillance(NNISS) System report, data summary from January 1992-hybe 2004m. *Am J Infect Control* 2004;32:470-85.
- Mantese VA, German DS, Kaminski DL, Herrman VM. Colonization and sepsis from triple-lumen catheters in critically ill patient. *Am J Surg* 1987;154:597-601.
- Hilton E, Haslett TM, Borenstein MT, Tucci V, Isenberg HD, Singerc C. Central catheter infection: Single versus triple lumen catheters. Influence of guide wires on infection rates when used for replacement of catheters. *Am J Med* 1988;84:667-72.
- Mozaffari K, Bakhshandeh H, Khalaj H, Soudi H. Incidence of Catheter-Related Infections in Hospitalized Cardiovascular Patients. *Res Cardiovasc Med*2013;1:99-103.
- Fridkin SK, Pear SM, Williamson TH, Galgiani JN, Jarvis WR. The role of understaffing in central venous catheter-associated bloodstream infections. *Infect Control Hosp Epidemiol* 1996;17:150-8.
- Barsanti MC, Woetje KF. Infection prevention in the intensive care unit. *Infect Dis Clin N Am* 2009;23:703-25.
- Moro ML, Viganò EF, Cozzilepri A. Risk factor for central venous catheter-related infections in surgical and intensive care units. The Central Venous Catheter-Related Infections Study Group. *Infect Control Hosp Epidemiol* 1994;15:253-64.
- Egebo K, Toft P, Jakobsen CJ. Contamination of central venous catheters. The skin insertion wound is a major source of contamination. *J Hosp Infect* 1996;32:99-104.
- Bjornson HS, Colley R, Bower RH, Duty VP, Schwartz-Fulton JT, Fischer JE. Association between microorganism growth at the catheter insertion site and colonization of the catheter in patients receiving total parenteral nutrition. *Surgery* 1982;92:720-7.
- CooperGL, HopkinsCC. Rapid diagnosis of intravascular catheter-associated infection by direct Gram's staining of catheter segments. *N Engl J Med* 1985;312:1142.
- Rosenthal VD, Gusman S, Migone O, Crnich CJ. The attributable cost, length of hospital stay, and mortality of central line-associated bloodstream infection in intensive care departments in Argentina: A prospective, matched analysis. *Am J Infect Control* 2003;31:475-80.
- Barsanti MC, Woetje KF. Infection prevention in the intensive care unit. *Infect DisClin N Am* 2009;23:703-25.
- Sharif A, Emami A, Mazouchi T, Mosavi S, Sharif M, Verdi J, *et al.* Venous catheter infection of patients admitted to ICU and its related factors. *KAUMS Journal (FEYZ)*2002;6:53-8.
- Shirazi M, Farhangnejad M, Golmohammadi R, Ranjbar R. Intra vascular catheter associated bacterial infections in admitted patient. *Iranian J Infect Dis* 2009;44:31-3.
- Grothe C, da Silva Belasco AG, de CássiaBittencourt AR, Vianna LA, de Castro CintraSesso R, Barbosa DA. Incidence of bloodstream infectionamong patients on hemodialysis by central venous catheter. *Rev Latino-am Enfermagem* 2010;18:73-80.
- Andrew G, Kirsteen S, Louise B, Shaun M, Chris J S, Suzanne M, *et al.* Elimination of central-venous-catheter-related bloodstream infections from the intensive care unit. *BMJ QualSaf*2011;20:174-80.
- Mesiano ER, Merchán-Hamann E. Bloodstream infections among patients using central venous catheters in intensive care units. *Rev Lat Am Enfermagem* 2007;15:453-9.

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