Original Article

Intravascular Catheter Colonization and Related Bloodstream Infection in Madani Cardiac Surgery Center

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(Received 12 Sep 2009; Accepted 8 Nov 2009)

Abstract

Background: Venous and arterial catheters are used ordinary for continuous hemodynamic evaluation in cardiac surgery intensive care units. The catheters are one of the most important risk factors for nosocomial infection and mortality of hospitalized patients. The aim of this study was to evaluate the rate of bacterial colonization of intravascular catheters and catheter related bloodstream infection in Shahid Madani intensive care unit.

Methods: 150 admitted patients that had intravascular catheter for more than 48 hours were enrolled in this study during one year period. The tip segment of catheters and insertion site cultures were assessed.

Results: The rate of colonization was 13(8.7%). The isolated bacteria were Escherichia coli(23.1%), Pseudomonas aeroginosa(23.1%) staphylococcus aureus(7.7%), coagulase negative staphylococcus(7.7%), Proteus vulgaris(7.7%), Stenotrophomonas maltophilia(7.7%), Candida albikans(7.7%), nonfermentative gram negative bacilli(7.7%) and Acinetobacter spp(7.7%).

Conclusion: The rate of catheter colonization was acceptable in comparison to the other studies. The most common isolated bacteria were Escherichia coli and Pseudomonas aeroginosa. In this study, the important risk factors were duration of catheter use, duration of hospitalization and positive blood culture.


Keywords: Catheter Colonization • Catheter Related Bloodstream Infection • Central Venous Catheters

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Introduction

Primary bloodstream infection is the fourth most common nosocomial infection and intravascular devices are the second source of primary bloodstream infection. A variety of factors, including the patient related, catheter composition and microorganism-catheter surface interactions contribute to the ultimate development of a catheter related bloodstream infection. Vascular devices are indispensable in modern-day health care systems, especially in Intensive Care Units (ICUs). Although such catheters are necessary for vascular access but have some complications like, local site infection, Catheter Related Blood stream Infection (CRBSI) and others. The incidence of serious complications with central venous catheters (CVCs) is more than peripheral catheters, especially those which is placed in critically ill patients. These devices can become a dangerous and fatal if the recommended precautions are not considered by health work providers. Catheter related bloodstream infection is a common, expensive and fatal consequence of catheterization. In USA the incidence of CRBSI is 80000 cases per year which leads to 28000 deaths and a cost of 2.3 billion dollars annually. Intravascular colonization in surgical and ICU patients has been studied in several researches. In one case control study, 5% of ICU patients had catheter related bactremia, which 1.5% had a CRBSI. However there is not a large study on risk factors and epidemiology of bacterial colonization of arterial and venous catheters in cardiac surgery intensive care unit in our country. So in this study, we evaluated the incidence of catheter colonization and CRBSI in Shahid Madani heart surgery center.

Methods

150 patients hospitalized in cardiac surgery Intensive Care Unit, who had arterial or venous catheter were evaluated in this prospective cross-sectional study. Those catheters which were placed for more than 48 hours, were cultured and assessed. The study was performed in ICU of Shahid madani research center, Tabriz, Iran from Jan 2007 to Jan 2008.

Microbiological method

For sampling, skin of insertion site was cultured quantitatively. For each catheter, the 5 cm of catheter tip which transported in a sterile container was cultured semiquantitatively. Microorganisms were identified according to standard criteria. The sample from other sites of body were taken if necessary. Catheter related blood stream infection was considered if there is a bacteremia or fungemia in a patient with an intravascular catheter with at least one positive blood culture obtained from a peripheral vein and clinical manifestation (i.e., fever, chills, and/or hypotension) and no apparent source of the bloodstream infection except the catheter. Samples of patients were sent to lab for culture and other lab tests. Demographic data of patients were noted. ESR (Erythrocyte Sedimentation Rate), WBC (White Blood Cell) count and C-Reactive Protein were assessed for all patients. Data are presented as mean±SD and analyzed by statistical package SPSS version 16. Qualitative variables with student T-test (independent samples) and categorical variables were analyzed with contingency tables and chi-square test or Fishers Exact test were analyzed. P< 0.05 was considered statistically significant.

Results

Of 150 used catheters, 84 cases were central vein catheter, 64 cases were arterial catheter, and 2 cases were Swan-Ganz. 102 cases were male and 48 were female. From 13 cases of positive catheter culture, 4 cases (31%) were male and 9 cases (69%) were female. Statistics show that bacterial colonization of catheter was more in females than males in this study. Mean duration of hospitalization was 53±4 days in patients with positive catheter culture (13 cases of 150) and 20±1 in patients with negative catheter culture (137 cases of 150). There was a significant relationship between days of hospitalization and possibility of colonization and positive culture of catheter, which means that the chance of positive catheter culture is more in patients who are hospitalized for longer duration. Mean days of catheterization was 10 days in patients with positive colonization and 5 days in patients with negative colonization. There was a statistically significant relationship between the duration of catheterization and bacterial
colonization of the catheter; the more days of catheterization, the more positive catheter culture. The most common isolated bacteria of 13 cases of positive catheter culture are listed in Table 1. Of 150 patients, 146 cases (97.3%) had negative blood culture and 4 cases (2.7%) had positive blood culture. From 13 cases of positive catheter culture, 2 cases (15.5%) had simultaneous positive blood culture and 11 cases (84.5%) had negative blood culture.

Table 1 - Isolated bacteria from patients

<table>
<thead>
<tr>
<th>Type of bacteria</th>
<th>Number (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.coli</td>
<td>3 (23.1)</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>3 (23.1)</td>
</tr>
<tr>
<td>Acinetobacter spp.</td>
<td>1 (7.7)</td>
</tr>
<tr>
<td>Coagulase- Negative Staphylococci</td>
<td>1 (7.7)</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>1 (7.7)</td>
</tr>
<tr>
<td>Proteus vulgaris</td>
<td>1 (7.7)</td>
</tr>
<tr>
<td>Stenotrophomonas maltophilia</td>
<td>1 (7.7)</td>
</tr>
<tr>
<td>Candida albicans</td>
<td>1 (7.7)</td>
</tr>
<tr>
<td>Non fermentative gram negative bacilli</td>
<td>1 (7.7)</td>
</tr>
<tr>
<td>Summation</td>
<td>13</td>
</tr>
</tbody>
</table>

Two cases of positive blood culture were 1 case of candida and 1 case of Staphylococcus epidermidis. There was a significant relationship between the results of catheter culture and blood culture. (P<0.05). Of 13 patients with positive catheter culture, 5 cases (38.5%) had positive culture of other places which were in order: 2 cases of tracheal tube secretion (40%), 2 cases of wound secretion (40%), 1 case of heart tissue (20%). There was a statistically significant relationship between the positive catheter culture and positive culture of other places. (P<0.05). There was not a statistically significant relationship between ESR, WBC, CRP and catheter culture in this study. Table 2 shows the variables and related P values.

Table 2 - Different variables and their relationship to positive catheter culture

<table>
<thead>
<tr>
<th>variable</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>0.005</td>
</tr>
<tr>
<td>Age</td>
<td>0.08</td>
</tr>
<tr>
<td>Duration of hospitalization</td>
<td>0.001</td>
</tr>
<tr>
<td>Duration of catheterization</td>
<td>0.003</td>
</tr>
<tr>
<td>Positive culture of other places</td>
<td>0.002</td>
</tr>
<tr>
<td>Positive blood culture</td>
<td>0.03</td>
</tr>
<tr>
<td>CRP</td>
<td>0.64</td>
</tr>
<tr>
<td>ESR</td>
<td>0.86</td>
</tr>
<tr>
<td>WBC</td>
<td>0.87</td>
</tr>
</tbody>
</table>

Discussion

The results of this study showed that the rate of catheter colonization was 8.7% and the most prevalent organisms are Pseudomonas aeruginosa (23.1%) and E.coli (23.1%). In a study by Sandra et al. on 93 patients, the rate of catheter infection was 34%.7 Tomanovic et al. showed that of 289 catheter culture, 217 cases were positive and rate of catheter colonization was 46%.8 Catheter colonization was reported 7.5% and 9.3% in two other studies9,10. In a study performed in United States, 260 patients were assessed and catheter colonization was 21%11. As it is seen, the statistics of catheter colonization rate show different results in various studies. The rate of catheter colonization in our study is lower and more acceptable than these studies which may be because of education of healthcare workers about controlling infection, hand washing, skin preparation before catheter insertion, attention to maximal sterile barrier precautions during catheter insertion, appropriate site maintenance, avoiding femoral site if possible and removing unnecessary catheters. Gender, duration of hospitalization, duration of catheterization, simultaneous positive blood culture, and simultaneous positive cultures of other places had a significant relationship with bacterial colonization of catheters in this study (P<0.05). There was a significant relationship between the bacterial colonization of catheter and gender as bacterial colonization was more in females than males in this study. In a study performed by Nasia et al. the rate of catheter infection was more in females and it is considered as a risk factor for catheter colonization12. The relationship between bacterial colonization of catheter and gender is shown in different studies which have various results13-15. In our study more days of ICU stay was associated with more possibility of catheter colonization and infection. In one study there was a significant relationship between days of hospitalization and possibility of positive catheter culture, as duration of hospitalization is a risk factor for catheter infection and increases the rate of catheter colonization up to 6 times12,16. There was a significant relationship between days of catheterization and positive catheter culture in our study as the more days of catheterization, the more catheter colonization and infection. Moro and
coworkers showed that patients with intravenous catheters for more than 7 days were in higher risk of catheter colonization, infection and following catheter-related bacteremia\(^\text{10}\). As seen in our study, mean days of catheterization was 10 days in patients with positive catheter culture and 5 days in patients with negative catheter culture which these results are similar to the results of other studies\(^\text{10,12}\). There was a significant relationship between catheter colonization and simultaneous positive blood culture and also positive culture of other places. Other studies in this field show that simultaneous positive blood culture is variable in patients with positive catheter culture and differs from 8.7% to 33\%\(^\text{9,11,13,14,16}\).

**Discussion**

Physicians in critical care units must study their own patient populations to determine the incidence of significant catheter colonization and CRBSI and to develop appropriate guidelines for catheter exchange and site maintenance.

**Acknowledgment**

Special thanks to madani cardiac surgery intensive care unit staff, cardiovascular research center and laboratory unit.

**References**