



Risk factors for recurrent catheter-related infections after catheter-related bloodstream infections

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KEYWORDS

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Summary

Objectives: This study was performed to identify the risk factors for recurrent catheter-related infections (CRIs) following non-tunneled central venous catheter (CVC) reinsertion after catheter-related bloodstream infections (CRBSIs).

Methods: A retrospective cohort was constructed from a computer database for patients who underwent reinsertion of a non-tunneled CVC after a CRBSI during the period January 2004 to December 2007. Among these patients, recurrent CRI cases were selected through an electronic chart review, and the risk factors for recurrent CRI were investigated.

Results: Fifty-three patients who had had a reinserted non-tunneled CVC after a CRBSI were analyzed and 22 patients were considered as having recurrent CRIs (41.5%). Recurrent/persistent CRBSI after catheter reinsertion was observed in 16 patients, and six patients with systemic inflammatory response syndrome revealed positive results of an identical organism with the initial CRBSI in semi-quantitative reinsertion-catheter tip cultures. In multivariate analysis, fungal CRBSI compared with bacterial infection (adjusted hazard ratio (HR) 7.77, 95% confidence interval (CI) 1.71–35.36) and CRBSI occurrence during intensive care unit (ICU) care (adjusted HR 5.20, 95% CI 1.41–19.18) were revealed as independent risk factors for recurrent CRIs after catheter reinsertion on account of CRBSIs.

Conclusions: A substantial proportion of the patients with CRBSIs revealed recurrent CRIs after catheter reinsertion. Fungal CRBSIs when compared with bacterial infections and CRBSI occurrence during ICU care were independent risk factors for recurrent CRIs following catheter reinsertion after a CRBSI.

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Introduction

Vascular catheter-related bloodstream infections (CRBSIs) have become a leading cause of healthcare-associated bloodstream infections, and are associated with substantial mor-

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bidity and mortality.^{1–3} In the case of a suspected CRBSI, removal of the catheter is generally recommended for non-tunneled central venous catheters (CVCs).^{4,5} However, a substantial proportion of patients with CRBSIs require reinsertion of their CVC for various reasons, such as the administration of fluid therapy, medications, blood products, and parenteral nutrition. During catheter exchange for CRBSIs, guide-wire exchange appears to be associated with a greater risk of catheter colonization and catheter-related infections (CRI), however this finding has not been found to be statistically significant.⁶ In one study, the transfusion of blood products was found to be associated with recurrent CRBSIs.⁷ Both the removal of an 'old' catheter prior to a de novo insertion of a new line and antibiotic prophylaxis are also recommended during catheter exchange.⁸ However, data related to the risk factors associated with recurrent CRIs following catheter reinsertion are scarce. In this study, we organized a retrospective cohort of patients who had had a reinserted non-tunneled CVC after a CRBSI, and we investigated the risk factors contributing to their recurrent CRIs.

Materials and methods

Study population and hospital setting

We collected clinical data between January 2004 and December 2007 at a single 2000-bed tertiary hospital. Using the computer database, we constructed a retrospective cohort of patients who had revealed CRBSI as defined below. Among the CRBSI patients, eligible cases were selected through an electronic chart review for those who had had a reinserted non-tunneled CVC. The clinical findings and microbiology data were analyzed for the recurrent CRIs in this population. Patients with multiple CVCs during the CRBSI were excluded from the recurrent CRI analysis.

For CVC insertion, a chlorhexidine/silver sulfadiazine surface-treated polyurethane catheter (two-lumen central venous catheterization set with blue Flexip[®] ARROWg⁺ard-Blue[®] catheter, Teleflex, USA) was used for non-tunneled CVC insertion. Maximal sterile barrier precautions (gloves, gown, mask, cap, and large drape) and use of 2% chlorhexidine for skin antisepsis during CVC insertion were taken as standard of care by the institutional infection committee as suggested in the practice guidelines.⁹ In cases of recurrent or persistent CRBSIs, further occult infection foci were evaluated, including infective endocarditis, endophthalmitis, and infected thrombi.

Microbiologic criteria

CRBSI was defined by positive blood cultures obtained from a peripheral vein and semi-quantitative catheter tip cultures yielding more than 15 colonies for the same organism with an identical antimicrobial susceptibility, without an obvious source of infection apart from the central line.^{4,5} Patients with a single positive blood culture of coagulase-negative staphylococci (CNS) were excluded from the analysis.

Recurrent CRI was defined by the following criteria: (1) recurrent positive blood culture of identical organism after catheter exchange and three negative blood cultures; (2) persistent positive blood cultures after catheter exchange

and positive semi-quantitative reinsertion-catheter tip cultures (yielding more than 15 colonies) of an identical organism; (3) positive semi-quantitative reinsertion-catheter tip cultures (yielding more than 15 colonies) of an identical organism with systemic inflammatory response syndrome (SIRS) upon catheter removal, without an obvious source of infection apart from the central line.

Data collection and study design

Collected data included patient demographics, underlying comorbidities, types of initial catheter, administration of total parenteral nutrition/lipid formula/blood products via the reinsertion catheter, date of the CRBSI, date and time that the appropriate antibiotics were administered, date and time of catheter insertion/removal, isolated microorganisms, methods of catheter change (guide-wire vs. de novo site), and date/type of recurrence. Appropriate antibiotic administration was defined as parenteral administration of antibiotics for which the CRBSI-related microorganism revealed susceptibility, for more than 14 days. We defined three parameters related with catheter reinsertion to identify the risk factors contributing to recurrent CRI during a catheter exchange: (1) catheter removal after CRBSI: time between the initial CRBSI and the catheter removal; (2) catheter exchange interval: time between the initial catheter removal and the reinsertion of a CVC; and (3) pre-reinsertion treatment duration: time between the initiation of the appropriate antibiotics for the CRBSI and the CVC reinsertion.

The primary endpoint was recurrence of the CRI after the reinsertion of a CVC. Mean comparisons for the continuous variables were done using independent Student *t*-tests. Proportion comparisons for the categorical variables were done using Chi-square tests, and a Fisher's exact test was used when the data were sparse. Multivariate logistic regression analyses with a stepwise model selection procedure were performed to identify independent risk factors contributing to recurrent CRIs after CRBSIs and CVC reinsertion. Predefined variables which have been known to be associated with recurrent CRIs and variables revealing $p < 0.1$ in our study were included in the final model. Kaplan–Meier survival analyses were performed to estimate catheter survival without recurrent CRI according to independent variables identified in the multivariate logistic regression model. Significance was set at $p < 0.05$ using two-sided comparisons, and all of the analyses were performed using SAS version 9.1.3 (SAS Institute, Inc., Cary, NC, USA).

Results

During the study period, 151 CRBSI cases were identified. *Candida albicans* was the most common pathogen ($n = 44$, 29.1%), followed by *Staphylococcus aureus* ($n = 21$, 13.9%) (Table 1). Most cases were associated with non-tunneled CVCs (81.5%); venous ports were the next most common (11.3%). Among 123 non-tunneled CVC CRBSIs, the most frequent insertion site was the femoral vein (43.9%), followed by the subclavian (33.3%) and jugular (22.0%) veins. The median interval between the initial catheter insertion and the CRBSI was 17 days (interquartile range 10–25 days).

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