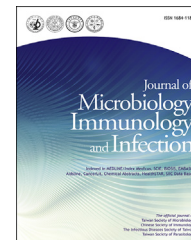




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ORIGINAL ARTICLE

Central line-associated bloodstream infections among critically-ill patients in the era of bundle care



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KEYWORDS

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Risk factor

Abstract *Background/Purpose:* Patients admitted to intensive care units (ICUs) are at high risk for central line-associated bloodstream infections (CLABSIs). Bundle care has been documented to reduce CLABSI rates in Western countries, however, few reports were from Asian countries and the differences in the epidemiology or outcomes of critically-ill patients with CLABSIs after implementation of bundle care remain unknown. We aimed to evaluate the incidence, microbiological characteristics, and factors associated with mortality in critically-ill patients after implementation of bundle care.

Methods: Prospective surveillance was performed on patients admitted to ICUs at the National Taiwan University Hospital, Taipei, Taiwan from January 2012 to June 2013. The demographic, microbiological, and clinical data of patients who developed CLABSI according to the National Healthcare Safety Network definition were reviewed. A total of 181 episodes of CLABSI were assessed in 156 patients over 46,020 central-catheter days.

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Results: The incidence of CLABSI was 3.93 per 1000 central-catheter days. The predominant causative microorganisms isolated from CLABSI episodes were Gram-negative bacteria (39.2%), followed by Gram-positive bacteria (33.2%) and *Candida* spp. (27.6%). Median time from insertion of a central catheter to occurrence of CLABSI was 8 days. In multivariate analysis, the independent factors associated with mortality were higher Pitt bacteremia score [odds ratio (OR) 1.41; 95% confidence interval (CI) 1.18–1.68] and longer interval between onset of CLABSIs and catheter removal (OR 1.10; 95% CI 1.02–1.20), respectively.

Conclusion: In institutions with a high proportion of CLABSI caused by Gram-negative bacteria, severity of bacteremia and delay in catheter removal were significant factors associated with mortality.

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Introduction

Central lines are widely used in critically-ill patients. Since central lines are increasingly prevalent, it is important to note that central line-associated bloodstream infection (CLABSI) is a leading cause of preventable health care-associated infections (HAIs) and that catheter-related bloodstream infections (CRBSI) have resulted in longer hospital stays, higher hospital costs, and significant mortality.^{1–3} Fortunately, surveillance of CLABSIs followed by implementation of improvement strategies can reduce CLABSI incidence and associated morbidity and mortality.^{3,4}

After incorporating preventive measures into an interventional bundle, the authors of a 2006 study observed a decrease in CLABSI rate.⁵ Following this observation, several studies conducted in Western industrialized countries proposed that achieving and maintaining a rate of zero CLABSI was possible with the implementation of preventive measures,^{6–8} however, CLABSIs remain a major component of HAIs in developing countries, where the target of zero CLABSI was reached in only a few studies.^{7,9} CLABSIs are observed more frequently in intensive care units (ICUs). The high rates of CLABSI in ICUs have been attributed to poor compliance with the interventional bundle, inappropriate development of additional preventive measures, and differences in microbiological epidemiology.⁷ The causative microorganisms of CLABSIs reported from the developing countries were predominantly Gram-negative bacteria, with trends of increasing incidence in recent years.^{10–13} With the aforementioned preventive measures, reduction in CLABSIs caused by *Staphylococcus aureus* was more significant than CLABSIs caused by Gram-negative bacteria and *Candida* spp.¹⁴ Further analysis of microbiological data should enable further development of pathogen-specific preventive measures.

Although there have been many international CLABSI studies, few have focused on the clinical characteristics of CLABSIs in Asian countries.^{7,15,16} In the 2011 report from the Taiwan Nosocomial Infections Surveillance System (TNIS), bloodstream infections topped the list of HAIs (39.8%) in ICUs in Taiwan. In this study, we aimed to evaluate the epidemiology, microbiological data, and risk factors associated with mortality from CLABSI among patients admitted to an ICU in a tertiary medical center.

Methods

Hospital setting and patient population

The National Taiwan University Hospital, Taipei, Taiwan is a large medical center that provides both primary and tertiary care. A CLABSI interventional bundle has been implemented according to the recommendations of Centers for Disease Control and Prevention (CDC) guidelines in all units of our hospital since 2011. The elements of the care bundle included hand hygiene, maximal barrier precautions, skin antisepsis with 2% chlorhexidine alcohol (Panion & BF Biotech, Inc., Taipei, Taiwan), optimal catheter site selection, catheter-site dressing regimens, and daily evaluation and removal of unnecessary catheters.⁴ The daily mean of catheter-days was defined as the mean of daily number of total central-catheter days, and catheter utilization rate was calculated by dividing the number of catheter days by the number of patient days.^{17,18} In 2011 before the implementation of bundle care, the rate of CLABSI was 7.40 per 1000 central-catheter days, with a daily mean of 89.0 catheter-days and a catheter utilization rate of 64.4% in ICUs.

In this study, a total of 150 adult ICU beds (44 medical ICU beds, 39 cardiac care unit beds, 12 neurologic ICU beds, and 55 surgical ICU beds) were included in the high-risk units under surveillance. The ratio of nurses to ICU patients was 1:2. Prospective active surveillance was performed by infection-control nurses in all adult patients admitted to ICUs between January 2012 and June 2013. Antimicrobial impregnated catheters were not routinely used unless patients developed recurrent bacteremia or were at high risk for catheter-related bloodstream infections, including those with higher Charlson comorbidity indices and nosocomial origins of infection.¹⁹

During the study period, all patients aged ≥ 18 years and having one or more central-line catheterization were enrolled in this study. We monitored CLABSI episodes from central-line insertion until catheter removal, discharge from the ICU, or death. Given that a patient could develop more than one CLABSI episode, a new episode was defined by the isolation of a different microorganism from subsequent blood cultures.²⁰

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