

Evolution and aetiological shift of catheter-related bloodstream infection in a whole institution: the microbiology department may act as a watchtower

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Abstract

The incidence of central-line-associated bloodstream infection (CLA-BSI) is reported per 1000 days of catheter exposure, mainly in the intensive care unit (ICU), because recording exposure throughout an institution is not always feasible. Confirmation of catheter-related bloodstream infection (CR-BSI) requires specific laboratory testing that identifies the catheter as the source of infection. This information is available in microbiology laboratories and can be assessed using a denominator of 1000 admissions. We evaluated recent trends in the incidence and aetiology of CR-BSI and compared adult ICUs with the remaining areas of the hospital in a retrospective cohort analysis of all confirmed CR-BSIs. During the 8-year study period, we recorded 1208 episodes (8.2% of BSIs) of CR-BSI. After adjusting for the blood cultures drawn, a significant reduction in incidence was observed in adult ICUs (47%), where care bundles had been applied. The reduction was similar irrespective of whether CLA-BSI or CR-BSI was assessed. We recorded a significant reduction in the incidence of *Staphylococcus aureus* CR-BSI, and a significant increase in the incidence of CR-BSI caused by *Enterococcus* sp., Gram-negative microorganisms and fungi. The microbiology department may complement CLA-BSI/1000 catheter-days by providing CR-BSI when days of exposure are not available, because both figures are parallel. We demonstrated a significant reduction in the incidence of CR-BSI in recent years in the population admitted to adult ICUs but not in the remaining areas of the hospital. A shift in the aetiological spectrum of CR-BSI may be occurring.

Keywords: Bacteraemia, blood cultures, catheter-related bloodstream infection, catheter-related infections, central line-associated bloodstream infection, vascular catheter

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Introduction

Evolution of the incidence of central-line-associated bloodstream infection (CLA-BSI) has been assessed mainly in adult intensive care units (ICUs) where care bundles have been implemented in recent years [1–3]. However, a significant number of CLA-BSI episodes occur outside the ICU, in areas where quality control programmes are not always imple-

mented. Information regarding the evolution of CLA-BSI throughout an institution is scarce, probably due to the difficulty in determining the number of days of exposure to a catheter. Furthermore, confirmation of CLA-BSI does not require microbiological laboratory testing; therefore, the problem may be overestimated, and infection could be attributed to other causes [4]. New and easier methods to report hospital-wide trends are clearly required [5].

By contrast, catheter-related bloodstream infection (CR-BSI) requires specific laboratory testing that more thoroughly identifies the catheter as the source of infection. This information is always available in the microbiology department and can be reported against the denominator of 1000 admissions

or 1000 days of stay, both of which are readily available in hospitals.

Data regarding secular trends in the incidence and aetiology of CR-BSI in general hospitals are very scarce [6], and most findings are biased by the selection of specific units and patients or short study periods [7–9].

The aim of our study was to assess secular trends in the incidence and aetiology of CR-BSI in a large general hospital using the microbiology laboratory as a watchtower. We also compared CR-BSI in the adult ICUs with the remaining areas of the hospital.

Material and Methods

Our hospital is a general teaching institution serving a population that ranged from 704 030 to 806 769 inhabitants during the study period (January 2003–December 2010). The number of beds available decreased from 2500 to approximately 1550 during this period as a result of the opening of new primary care hospitals to absorb less complex patients. Our hospital provides all the services of a general teaching hospital. We included all blood and catheter samples sent for bacterial and fungal culture to our laboratory during the study period.

Blood culture systems

Our institution recommends extraction of three blood samples for evaluation of all episodes of suspected bacteraemia or fungaemia. Blood cultures were processed using BACTEC 9240 (Becton Dickinson Microbiology Systems, Maryland, DE, USA). Methods for processing positive blood cultures were standard [10].

Catheter cultures

In our hospital we followed CDC Guidelines for sending vascular catheter tips from patients with clinical suspicion of sepsis for culture in the Microbiology Department [4]. All catheter tips were cultured immediately according to the semi-quantitative roll-plate technique [11]. All microorganisms present in counts ≥ 15 colony-forming units (CFUs) were identified to genus and species level, and information on antimicrobial susceptibility was recorded.

Definitions

An episode of 'significant' bloodstream infection was defined as an episode of bacteraemia or fungaemia, in which those pathogens were present in ≥ 1 blood cultures. We considered commensal microorganisms [coagulase negative Staphylococci (CNS), *Corynebacterium* sp. (except *C. jeikeium*), *Lactobacillus* sp., *Bacillus* sp. and *Propionibacterium* sp., or

viridans group *Streptococcus* isolates and *C. perfringens*] as probable pathogens when they were recovered in ≥ 2 blood cultures. In the case of neonates, due to the difficulty in obtaining blood from these patients and following standard recommendations, we accepted as significant the presence of CNS or other potential contaminants in both bottles of a single venous puncture. Only the number of patients—not the number of blood cultures—was taken into consideration. All microorganisms isolated from blood from the same patient within 1 week were considered a single episode.

The definitions for catheter infections are those detailed in the Clinical Practice Guidelines for the Diagnosis and Management of Intravascular Catheter-Related Infection [4]. In summary, CR-BSI was defined as those episodes in which the same microorganism was recovered from blood and a catheter segment with an interval of < 8 days, provided that there was no infection at another site. Other CR-BSI episodes diagnosed by quantitative blood cultures or differential time to positivity (DTTP) were excluded. Central-line-associated bloodstream infection (CLA-BSI) was defined as having a primary bloodstream infection (BSI) in a patient with a central line in place within a 48-h period before onset of the BSI that was not related to infection at another site.

Microorganisms recovered from blood or catheters were identified using the automated MicroScan system with the POS Combo Panel Type 2S and NEG Combo Panel Type 1S (DADE Behring, Sacramento, CA, USA).

Implementation of catheter care bundles

In 2009, our institution joined a national programme to implement a catheter care bundle in adult ICUs, with the intention of reaching zero incidence of CLA-BSI. This consisted of incorporating the following five evidence-based procedures recommended by the CDC: hand hygiene, using full-barrier precautions during the insertion of central venous catheters, cleaning the skin with chlorhexidine, avoiding the femoral site if possible, and removing unnecessary catheters [3].

Statistical analysis

The database of episodes of significant BSI was prospectively updated on a daily basis by the same member of staff of the microbiology laboratory from the beginning of the study. This database also included all endovascular catheters during the study period.

The global incidence of BSI and CR-BSI is expressed as episodes per 1000 admissions.

Overall trends in rate per month over time were adjusted using Poisson regression analysis to estimate the incidence rate ratio (IRR) with a 95% confidence interval (95% CI) adjusted for the number of monthly blood cultures. In order

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