Journal of Infection (2011) 62, 130–135

BIAM British Infection Association

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Epidemiology, microbiology and outcomes of healthcare-associated and community-acquired bacteremia: A multicenter cohort study

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Accepted 22 December 2010
Available online 30 December 2010

KEYWORDS
Healthcare;
Bacteremia;
Outcome;
Community-acquired

Summary *Objectives:* Classically, infections have been considered either nosocomial or community-acquired. Healthcare-associated infection represents a new classification intended to capture patients who have infection onset outside the hospital, but who, nonetheless, have interactions with the healthcare system. Regarding bloodstream infection (BSI), little data exist differentiating healthcare-associated bacteremia (HCAB) from community-acquired bacteremia (CAB). We studied the epidemiology and outcomes associated with HCAB.
Methods: We conducted a multicenter, retrospective chart review at 7 US hospitals, of consecutive patients admitted with a BSI during 2006, who met pre-defined selection criteria. We defined HCAB as a BSI in a patient who met $\geq$1 of the criteria: 1) hospitalization within 6 months; 2) immunosuppression; 3) chronic hemodialysis; or 4) nursing home residence. The rest were classified as CAB. We examined patient demographics, severity of illness, and in-hospital mortality rates by HCAB vs. CAB status. A bootstrap logistic regression model was developed to quantify the independent association between HCAB and hospital mortality.
Results: Of the total 1143 patients included, HCAB accounted for 63.7%, with the percentage ranging from 49.0% to 78.1% across centers. HCAB patients were older (58.5 $\pm$ 17.5 vs. 55.0 $\pm$ 19.9 years, $p = 0.003$) and slightly more likely to be male (56.1% vs. 50.2%, $p = 0.044$) than those with CAB. HCAB was associated with a higher mean Acute Physiology Score (12.6 $\pm$ 6.2 vs. 11.4 $\pm$ 5.7, $p = 0.009$) and recent hospitalization was the most prevalent criteria for defining HCAB (76.5%). Hospital LOS was longer in the HCAB (median 8, IQR 5–15

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doi:10.1016/j.jinf.2010.12.009

days) than CAB (median 7, IQR 4—13 days) group ($p = 0.030$). In a multivariable model, the risk of hospital death was 3-fold higher for HCAB compared to CAB (adjusted odds ratio 3.13, 95% CI 1.75—5.50, $p < 0.001$, AUROC = 0.812).
Conclusions: HCAB accounts for a substantial proportion of all patients with BSIs admitted to the hospital. HCAB is associated with a higher mortality rate than CAB. Physicians should recognize that HCAB is responsible for many BSIs presenting to the hospital and may represent a distinct clinical group from CAB.

Introduction

Over the last two decades, healthcare delivery has evolved. Many patients who classically would remain in the hospital for treatment are either now transitioned to nursing homes or to non-acute care facilities. Because of efforts at more rapid patient discharge, overall durations of hospitalizations are decreasing,[1] moving many of the traditionally hospital-based interventions into the ambulatory setting. At the same time, epidemiologic studies document a shift in the microbiology of infections developing outside the confines of the hospital. Specifically, organisms such as methicillin-resistant *Staphylococcus aureus* (MRSA) and *Pseudomonas aeruginosa* (PA) are now noted as causes of both pneumonia and skin infections in persons presenting to the emergency department.[2—5] This observation coupled with ongoing trends in healthcare organization and delivery has led to the development of the concept of the healthcare-associated infection. The purpose of this designation is to help clinicians identify subjects who, despite developing infections as outpatients, are at heightened risk for pathogens classically considered nosocomial in origin.[2,3,6—9]

Most prior efforts to evaluate the prevalence and microbiology of healthcare-associated infections have predominantly focused on pneumonia. Kollef et al. observed that persons with healthcare-associated pneumonia (HCAP) were both more likely to be infected with either MRSA or PA and faced higher mortality rates than those with community-acquired pneumonia (CAP).[2] Other analyses of HCAP have confirmed these observations and documented that HCAP appears to exist as a distinct disorder outside the US as well.[3,10—12]

Understanding this shift in infectious syndromes is crucial. Without precise information regarding epidemiology and microbiology, clinicians cannot design and prescribe empiric antibiotic regimens that are active against the likely pathogens. In turn, this exposes patients to the risk of initial inappropriate therapy and consequently worsened outcomes.[3,13—15]

Although there is a growing consensus that HCAP is a distinct clinical entity in the spectrum from CAP to hospital-acquired pneumonia,[16] less is known about the significance of other healthcare-associated infections. Efforts addressing healthcare-associated bacteremia (HCAB) in a multi-institutional way have been limited.[9] Because of this, we conducted a multicenter, retrospective analysis of bloodstream infections (BSIs) presenting to the hospital. We sought to determine if HCAB is, in fact, a unique syndrome and to describe its epidemiology and outcomes.

Methods

We conducted a retrospective multicenter cohort study in seven large urban academic medical centers (New York University Langone Medical Center — 1069 beds; Creighton University Medical Center — St. Joseph's Hospital- 738 beds; Barnes-Jewish Hospital — 1252 beds; Northwestern Memorial Hospital — 600 beds; Mayo Clinic-Saint Mary's Hospital, Rochester — 1157 beds and Rochester Methodist Hospital — 794 beds; University of Texas Health Science Center at San Antonio — 600 beds; Henry Ford Hospital — 805 beds). The Institutional Review Board of each of the participating hospitals approved the study.

Definitions

Subjects

We reviewed the medical records of consecutive patients presenting to the hospital between January 1 and December 31, 2006 with a BSI diagnosed based on blood cultures drawn at presentation (i.e., within 24 h of being admitted to the hospital). We only included adults ($\geq$18 years of age) and those who were subsequently hospitalized $\geq$ 24 h. Blood cultures were obtained and analyzed as per each institution's local practice. All final culture result interpretations were made by trained microbiology personnel. Patients were excluded if their infection had been diagnosed in a hospital other than the index institution. Coagulase-negative *staphylococci* was deemed a contaminant and thus not included in the analyses.

Healthcare-associated bacteremia

We defined HCAB based on the presence of one of the following criteria: 1). Admission from a skilled nursing facility, 2). Previous hospitalization within 6 months, 3). Need for hemodialysis, 4). Immune suppression. Immune suppression was defined as any of the following: current use of >5 mg/day of prednisone (or its equivalent); recent chemotherapy or radiation therapy; human immunodeficiency virus infection; primary or secondary immunodeficiency syndrome; or a history of solid organ or bone marrow transplant. All cases of bacteremia present at hospitalization not meeting any of the HCAB criteria were classified as community-acquired (CAB). Bacteremia was defined as primary if it was identified as the only source of infection (i.e., not related to an infection elsewhere, such as the lung, urine, etc.).

Appropriate antibiotic therapy

Appropriate antibiotic therapy requires that two aspects be met: initial empiric therapy had to be timely (initiated