Nosocomial bloodstream infections in ICU and non-ICU patients

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Background: Nosocomial bloodstream infections (BSI) create a serious health problem in hospitals all over the world. The objectives of our study were to explore putative disease markers and potential risk factors with nosocomial BSI in patients in intensive care units (ICU) and non-ICU patients and to determine risk factors associated with increased 28-day mortality rate in patients with nosocomial BSI acquired in combined medical-surgical ICU. However, the major purposes of this report were to identify epidemiologic differences between nosocomial BSI acquired in ICU and non-ICU, as well as analyses outcomes for patients with nosocomial BSI acquired in ICU.

Methods: A 1-year prospective cohort study was performed to determine the incidence of nosocomial BSI in hospitalized patients. Patient characteristics, risk factors related to health care, and source of infection of patients with BSI acquired in non-ICU were compared with those patient with BSI acquired in ICU. Also, nested case-control study of patients to nosocomial BSI acquired in ICU was performed to evaluate outcome. Patients were identified by active surveillance and positive blood culture during the study period.

Results: The incidence of nosocomial BSI was 2.2 per 1000 admission in non-ICU patients and 17.4 per 1000 admission in ICU patients. The 28-day crude mortality rate was 69% in ICU patients. A multivariate model showed that nasogastric tube (RR, 25.1; 95% CI: 3.845-163.85; $P = .001$), mechanical ventilation (RR, 13.04; 95% CI: 1.974-96.136; $P = .008$), and H2 blockers (RR, 12.16; 95% CI: 1.748-84.623; $P = .012$) were more prevalent among patients with BSI acquired in ICU, and aggressive procedures (RR, 8.65; 95% CI: 1.70-44.00; $P = .009$) were more prevalent among patients with BSI acquired in non-ICU patients. Risk factors independently associated with increased 28-day mortality rate in ICU patients were mechanical ventilation (OR, 8.63; 95% CI: 1.5-49.8; $P = .016$) and SAPS II >40 (OR, 6.0; 95% CI: 1.0-35.7; $P = .049$). The most common isolated nosocomial BSI pathogens (in both groups of patients) were coagulase-negative *staphylococci* (21%), *Staphylococcus aureus* (14%), and *Klebsiella* species (13%). *Klebsiella* species was the only organism independently influencing the poor outcome of nosocomial BSI in ICU patients (OR, 4.3; 95% CI: 1.2-15.3; $P = .022$).

Conclusions: Our results show epidemiologic differences between non-ICU and ICU BSI. Also, this study suggests that severity of underlying host conditions, mechanical ventilation, and microbial agents (*Klebsiella* species) affect the outcome of NBI in patients in ICU. (Am J Infect Control 2005;33:333-40.)

Nosocomial bloodstream infections (BSI) create a serious health problem in hospitals all over the world.[1-4] They contribute to greater morbidity and mortality rates, as well as to increasing length of hospital stay and health care costs.[5,6]

The reported incidence of nosocomial BSI ranges from 1.3 to 18.4 episodes per 1000 hospital admissions, varying with the type of population studied, the size of institution and ward location, and length of hospital stay.[3,6,7] Patients admitted to intensive care units (ICU) carry an even higher risk of nosocomial BSI than those admitted to other types of units (non-ICU).[8-11]

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Recent data from the Surveillance and Control of Pathogens of Epidemiologic Importance (SCOPE) surveillance system in United States hospitals showed that 49.4% of all nosocomial BSI occurred in ICU.[12]

The crude mortality rate from nosocomial BSI extremely varies, ranging from 12% to 80%.[8-11] Some studies showed that poor outcome of patients with nosocomial BSI was associated with age, severity of underlying conditions, and microbial agents.[12-14]

Surveillance of nosocomial BSI provides useful data in identifying infected patients and in identifying factors that contribute to development and outcome of nosocomial BSI.[15] The moment infection problems are recognized, surveillance data allow the hospital to take appropriate intervention measures and to evaluate their efficacy.[16,17] This study was carried out to identify groups of patients at special risk for nosocomial BSI and to enable targeting specific preventive measures to these patients.

METHODS

Setting

The Medical Military Academy is a 1200-bed tertiary care center divided in 25 departments (according

to medical specialty). Surveillance of nosocomial BSI included all patients in several non-ICU departments: surgical (gastrointestinal surgery; chest surgery, including coronary surgery; vascular surgery; neurosurgery; plastic surgery), medical departments (gastroenterology, rheumatology, nephrology, pulmology, hematology), and patients in combined medical-surgical ICU (surgical, toxicology, and medical).

Study Design

We conducted a 1-year hospital cohort study. Patients with nosocomial BSI were identified by prospective active surveillance and positive blood culture during the study period, from January 1 to December 31, 2000. Further analysis was limited to the above-mentioned patients. Reviewing the clinical chart information on patient characteristics, risk factors related to health care, and source of infection of patient with BSI were collected. We gathered data on the following variables: intrinsic factors (existing at admission) including sex, age, primary diagnosis, serum albumin <30 g/L, neutropenia, diabetes, arterial hypertension, and simplified acute physiologic score (SAPS) II for ICU patient with NBI and factors related to health care, including hospital length of stay from admission to NBI, previous surgery, hemodialysis, aggressive procedures, nasogastric tube, mechanical ventilation, central venous catheter, indwelling urinary catheter, transfusion of blood and blood products, total parenteral nutrition, received corticosteroids, and received histamine type-2 antagonists. Clinical and microbiologic data were also recorded: type of infection and microorganisms identified in blood and in other cultures, as well as antimicrobial sensitivity tests. All patients with nosocomial BSI in non-ICU were compared with those with nosocomial BSI in ICU. Also, we conducted a nested case-control study with all patients with nosocomial BSI in ICU. Those who died were compared with those who survived.

Definitions

The definition of the Centers for Disease Control and Prevention (CDC) for nosocomial BSI was used, and only laboratory-confirmed nosocomial BSIs were included in the study.[12,18] One positive blood culture was sufficient for commonly accepted pathogens, whereas, for potential skin contaminants (coagulasa-negative staphylococci, diphteroides, α-hemolytic streptococci, *Bacillus* species, *Propionibacterium* species, micrococci, and *Neisseria* species other than *gonorrhoeae* and *meningitidis*), only the finding of 2 or more positive blood cultures, with identical antimicrobial susceptibility profiles, obtained within 5 days, was accepted.[19] Primary nosocomial BSI referred to bacteremia (or fungemia) for which no documented distal source existed, including those resulting from intravenous or artherial catheter infections.[18] Secondary nosocomial BSI was defined as an infection that developed as a consequence of documented infection of the same microorganism, with an identical resistance pattern at another body site.[18] Polymicrobial nosocomial BSI was defined as the isolation of different species in 1 or more blood cultures within 48 hours.[20] The primary diagnosis at admission were classified according to *International Classification of Diseases, Tenth Revision* (ICD-10) codes.[21] Severity was determined on admission with simplified acute physiologic score (SAPS II) for the patients in ICU only.[22] Neutropenia was defined as total peripheral white blood counts <1000 mm^3 or polymorphonuclear neutrophil count <500 mm^3 prior to occurrence of BSI.

All patients who entered the operating unit were recorded as having had surgery.[13] Aggressive procedures referred to medical techniques that enter sterile tissues or the vasculare system–cardiac catheterization, interventional radiology, biopsy, and endoscopic procedures.[23] The primary outcome measure examined was 28-day mortality.[13]

Microbiologic Methods

Blood samples were processed in the BacT/Alert System (bioMerieux, Marcy-l'Etoile, France). The identification of blood isolates was done using routine methods.[24] Suceptibility testing was done according to the national standards in selection of antibiotics for antibiogram typing.[25]

Statistical Analysis

The data were analyzed with the help of SPSS software (SPSS Inc, version 8.00, Chicago, IL). Results were expressed as the mean ± SD or as a proportion of the total number of patients. The χ^2 test or Fisher exact test were used for categoric variables and relative risk, and their corresponding 95% confidence intervals (CI) were calculated. For parametric continuous variables, mean values were compared using the Student *t* test. For nonparametric continious variables, the Mann-Whitney *U* test was used. A multivariate stepwise logistic regression analysis was performed using variables with significant differences or association in univariate analysis. The odds ratios (OR) and their corresponding 95% CIs for each variable were also calculated. Statistical significance was considered when *P* values were $<.05$.

RESULTS

From January 1 to December 31, 2000, a total of 161 cases of BSI were recorded. Among these, 90 (55.9%)