ORIGINAL ARTICLE

Epidemiology and antimicrobial resistance among commonly encountered bacteria associated with infections and colonization in intensive care units in a university-affiliated hospital in Shanghai

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Background/Purpose: The aim of this study was to classify intensive care unit (ICU) bacterial strains as either ICU-acquired or ICU-on-admission and to compare their epidemiological and antibiogram characteristics.
Methods: The study was performed in a 1300-bed university-affiliated hospital from January 1, 2006 to December 31, 2010. Based on the time of ICU admission, ICU isolates were classified as ICU-acquired strains (appearing more than 48 hours after admission) or ICU-on-admission strains (appearing 48 hours or less from admission). The microbiological data before ICU admission, the microbiological data, and susceptibility testing were compared between the ICU-acquired and ICU-on-admission bacterial isolates.
Results: The most common ICU-acquired strains were *Acinetobacter baumannii* (19.5%), *Pseudomonas aeruginosa* (15.6%), *Stenotrophomonas maltophilia* (11.5%), *Staphylococcus aureus* (10.7%), *Enterococcus* spp. (10.6%), and *Klebsiella pneumoniae* (9.7%). There were significant differences between ICU-acquired and ICU-on-admission isolates in the susceptibility rates of Gram-negative bacteria to antibiotics, especially the susceptibility of *A. baumannii* to imipenem [23.8% (ICU-acquired) vs. 44.4% (ICU-on-admission), $p < 0.001$] and meropenem (24.1% vs. 37.8%, $p < 0.001$), and the susceptibility of *P. aeruginosa* to imipenem (39.3% vs. 76.1%,

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$p < 0.001$) and meropenem (58.5% vs. 76.1%, $p < 0.05$). Furthermore, decreased susceptibility rates of *A. baumannii* and *P. aeruginosa* to carbapenems were correlated with an extended ICU stay ($p < 0.05$).

Conclusion: Because of decreasing susceptibility rates of pathogens (especially ICU-acquired strains) and a significant correlation with the length of ICU stay, intensivists should consider a patient's time of ICU admission and previous microbiological data and should distinguish ICU-acquired strains from non-ICU-acquired strains so as to initiate optimized empirical antibiotic therapy against ICU-acquired infections.

Introduction

Nosocomial infection has become an important worldwide public health problem and increases morbidity, mortality, and cost during a patient's hospital stay.[1–4] The prevalence of infections acquired in intensive care units (ICUs) is even higher than it is in general wards because of the severity of diseases, prolonged ICU and hospital stays,[5] immunosuppression of ICU patients, and greater number of interventions with invasive devices such as central-line catheters, invasive mechanical ventilations, Foley urine catheters.[6,7]

An ICU-acquired infection is defined as an infection occurring more than 48 hours after an ICU admission.[8] In a recent multicenter study involving 71 adult ICUs, 7.4% of the 9493 patients had an ICU-acquired infection.[9] ICU-acquired infections commonly include a central line-associated bloodstream infection (CLBSI, 40%), catheter-associated urinary tract infection (CAUTI, 31%), ventilator-associated pneumonia (VAP, 20%), and surgical site infection (SSI, 9%).[10,11] These ICU-acquired infections are the most common complications for patients during ICU stays and contribute to significant morbidity and mortality.[12]

Local epidemiological data and antibiograms are useful for optimized empirical antibiotic therapy for severe ICU-acquired infections. Antimicrobial susceptibility of pathogens can vary markedly between hospitals and different units within the same hospital. It is therefore necessary to monitor prevalence and antimicrobial susceptibility patterns to modify antimicrobial hospital policy, especially in ICUs. However, since many ICU admissions are the result of substantial infections,[9,13,14] most epidemiological studies on ICU-acquired bacterial strains include strains obtained outside the ICU. They thus have a bias with respect to actual antibiotic resistant patterns. Few epidemiological data are available on the prevalence, distribution, and antibiogram of ICU-acquired and ICU-on-admission strains (excluding "ICU" strains that are actually non-ICU strains).

The aim of this study was to classify ICU strains as ICU-acquired or ICU-on-admission, based on the length of time from the ICU admission [greater than 48 hours (ICU-acquired) or up to 48 hours from admission (ICU-on-admission)]. The microbiological data was classified before ICU admission. The epidemiological and antibiogram characteristics were compared.

Methods

Hospital settings

The study was performed at Ruijin Hospital (Shanghai, China), a 1300-bed university-affiliated hospital, from January 1, 2006 to December 31, 2010. Ruijin Hospital has three ICUs: a 12-bed surgical ICU (SICU) in which surgical intensive care patients and postoperative patients are cared for; a 10-bed respiratory ICU (RICU) in which general intensive care patients, especially patients with respiratory dysfunction, are cared for; and an 18-bed emergency ICU (EICU) in which most patients had been admitted from the emergency department.

Definitions

ICU isolates were classified as either ICU-acquired strains or ICU-on-admission strains. An ICU-acquired strain was defined as a bacterial species that was obtained more than 48 hours after the patient's ICU admission,[15] whereas an ICU-on-admission isolate was defined as a bacterial species that was obtained within 48 hours after the patient's ICU admission.

An extensively drug-resistant (XDR) pathogen was defined as a pathogen isolate that was resistant to all currently available systemic antibiotics such as cephalosporins, aztreonam, carbapenems, aminoglycosides, fluoroquinolones, and sulbactam (except for polymyxin B).[16]

Patients

Patients younger than 18 years old, patients whose ICU stay was either less than 72 hours or longer than 3 months, and patients readmitted to any ICU within 3 months were excluded from the comparison of the epidemiological and antibiogram characteristics of ICU-acquired and ICU-on-admission isolates.

Microbiological data and susceptibility testing

For patients admitted to ICU and then once weekly during their ICU stays, urine specimens and specimens from sputum or endotracheal tube aspirates were regularly collected and cultured for bacteria and fungi. Sputum, endotracheal aspirates, oral swabs, urine, blood,