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Evolving pathogens in the surgical intensive care unit: A 6-year experience

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Abstract

Background: Nosocomial infections in the intensive care unit (ICU) are well-known causes of morbidity and mortality in critically ill patients. Further complicating this issue is the ever-increasing number of multidrug-resistant pathogens. This study was designed to investigate and document changing microbial trends within the Los Angeles County/University of Southern California Medical Center surgical ICU (SICU), including drug-resistant pathogens.

Methods: A 6-year retrospective cohort study of all patients 18 to 85 years old with positive blood, urine, or sputum cultures admitted to an urban, level 1 trauma/SICU. Patients were identified through the Los Angeles County/University of Southern California Medical Center epidemiological records and computerized ICU database. The entire data set was analyzed according to pathogen classification schemes, culture date, type of infection, and with some patient characteristics including sex, average age, and Acute Physiology and Chronic Health Evaluation II score. Two groups were created to analyze changing trends: a past group (2000-2002 cultures) and a present group (2003-2005 cultures). Any repeated cultures were excluded, as was coagulase-negative *Staphylococcus*, which was considered a contaminant.

Results: Over the past 6 years, there were 1164 SICU patients who developed 2260 positive cultures (346 blood, 1,685 respiratory, 229 urine). The average age of patients was 43 ± 19 years, and their average Acute Physiology and Chronic Health Evaluation II score was 22 ± 12. Of the 1164 patients, 76% were male, and 64% suffered trauma injuries. Although there was no difference in the rate of positive blood cultures caused by Gram-positive (GP) or Gram-negative (GN) organisms in the past and present groups ($P = .32$), GPs became more common in the present group for both respiratory ($P < .0001$) and urine ($P = .004$) cultures. In both blood and respiratory cultures, oxacillin-resistant *Staphylococcus aureus* was a more common GP pathogen (22% vs 7%, $P = .004$ and 20% vs 11%, $P = .004$) and represented a larger proportion of staphylococcal species in the present group (50% vs 21%, $P = .01$ and 30% vs. 21%, $P = .04$).

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Conclusions: Our study found that within the SICU, GP organisms play an increasing pathogenic role in critical patients. Staphylococcal species have become more common pathogens in the last 6 years, with an increase in the proportion of drug-resistant strains (oxacillin-resistant *S aureus*). These findings illustrate the need to keep constant surveillance on microbial trends within the SICU, especially those among drug-resistant pathogens.

1. Introduction

Nosocomial infections are well known complications of any patient's stay in the hospital, especially to intensive care unit (ICU) patients. There is a wide body of research on the morbidity and mortality associated with nosocomial infections in this critical population. Certain patterns within this research are clear. For example, ICU patients are as much as 5 to 10 times as likely to develop a nosocomial infection as those on general medical wards [1-5]. In addition, critical care patients who contract nosocomial infections, especially bloodstream infections, show an increased risk of death compared to non-ICU patients with nosocomial bacteremia [6]. Risk factors predisposing critical patients to poor outcome from such infections include (1) intrinsic risk factors related to the need for intensive care, such as immunosuppression; (2) the use of invasive medical devices; and (3) crowding and inanimate reservoirs in the ICU that increase the risk of cross-infection [7].

Further complicating this issue, studies report that at minimum 10% to 20% of ICU bacteremias are caused by multidrug-resistant (MDR) pathogens [6,8]. In addition to their increased risk of infection, critical care patients are more susceptible to the morbidity and mortality of colonization by MDR bacteria [7].

Of the articles that focus on ICU-acquired nosocomial infections, there remain 2 areas in need of further research. First, many articles neglect evaluation of the microbial isolation rates of surgical ICU (SICU) patients separate from other hospital ICU patients. This may be a serious neglect, as SICUs are reported as having some of the highest pathogen reservoirs compared to other wards, including other ICUs [9-11]. Second, there is a paucity of evidence documenting the risk and the prevalence of particular organisms appearing most frequently in SICUs. This is a serious neglect, as Kollef et al [7,8,12] have demonstrated that when ICU patients receive inappropriate microbial therapy based on unknown resistance of an organism, it is the single most important determinant on inhospital ICU mortality. Therefore, it is of the utmost importance within the SICU to elucidate, as a preventative and therapeutic measure, local trends in microbial reservoirs, infection rates, and resistance with time. For this reason, this retrospective study was designed to investigate and document changing microbial trends, especially MDR pathogen groups, within our own Los Angeles County/University of Southern California Medical Center (LAC/USC) SICU.

2. Patients and methods

We performed a retrospective study of all adult surgical patients (trauma and non-trauma) admitted to the SICU at the LAC/USC during the 6-year period from January 2000 through December 2005. A prospectively maintained epidemiological database was queried to identify patients with culture results in the blood, sputum, or urine during their stay in the SICU, and only patients with a positive culture result were included in the study. Any repeated cultures were excluded, as was coagulase-negative *Staphylococcus*, which was considered a contaminant. Variables collected included age, sex, type of surgical admission (trauma or nontrauma), and Acute Physiology and Chronic Health Evaluation (APACHE) II score. The culture results were evaluated by Gram stain (positive or negative) and by specific causative organism. The population was divided into a past group (2000–2002) and a present group (2003–2005) and compared.

Statistical analysis was performed using Microsoft Excel 2002 (Microsoft Corp, Redmond, Wash) and GraphPad InStat 3 for Macintosh version 3.0b (GraphPad Software, San Diego, Calif). Values are reported as means + SD or raw percentage. χ^2 analysis, Fisher exact test, or Student t test were used to compare groups where appropriate. Difference was considered statistically significant at $P < .05$. The study was approved by the local institutional review board and was conducted under waiver of consent, as it involved only collection of data, and no intervention was performed on patients based on data obtained.

3. Results

During the study period there were 1164 SICU patients (43 ± 19 years old, 76% male, 64% trauma, APACHE II = 22 ± 12) admitted to our institution. The population developed a total of 2260 positive culture results (346 blood, 1685 respiratory, 229 urine). There were 690 patients in the past group (44 ± 19 years old, 75% male, 65% trauma, APACHE II = 22 ± 11) with 1410 positive culture results (214 blood, 1051 respiratory, 145 urine) and 474 patients in the present group (42 ± 19 years old, 79% male, 61% trauma, APACHE II = 20 ± 12) with 850 positive cultures (132 blood, 634 respiratory, 84 urine).

Within the blood culture results, the data showed no statistically significant difference in the total rate of positive