A multicentre analysis of epidemiology of the nosocomial bloodstream infections in Japanese university hospitals

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Abstract

Nosocomial bloodstream infections (BSIs) are an important cause of morbidity and mortality. The current study analysed data from a concurrent surveillance programme to examine the current epidemiological trends for nosocomial BSIs at 22 Japanese university hospitals from 1 April 2008 to 31 March 2012. The number of blood culture sets taken, the rate of multiple blood culture sets and the rates of antibiotic-resistant isolates among six major nosocomial BSI pathogens (*Staphylococcus aureus*, *Enterococcus* spp., *Escherichia coli*, *Klebsiella* spp., *Pseudomonas aeruginosa*, and *Candida* spp.) not including coagulase-negative staphylococci, were evaluated. The clinical characteristics of nosocomial BSIs caused by these pathogens were also collected for 2941 patients. The number of blood culture sets taken per bed increased during the 4-year study period (from 4.07 in 2008 to 5.37 in 2011), and the rates of multiple blood culture sets also increased (from 29.9% in 2008 to 50.0% in 2011). Methicillin resistance was detected in 50.2% of *S. aureus* isolates. The prevalence rates of extended-spectrum beta-lactamase-producing *E. coli* and *Klebsiella* spp. isolates increased annually during the study period, and the average prevalence rates were 12.3% and 5.8%, respectively. The overall crude mortality of nosocomial BSIs due to the six pathogens evaluated was 24.5% (43.2% in ICU settings and 20.5% in non-ICU settings). Thus, our multicentre study evaluated the current epidemiological trends for nosocomial BSIs, and we found that further efforts are needed to increase the use of multiple blood culture sets and improve the prognosis of nosocomial BSIs in Japanese university hospitals.

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Introduction

Nosocomial bloodstream infections (BSIs) are a major cause of morbidity and mortality worldwide [1,2]. The incidence of nosocomial BSIs is increasing, as is the prevalence of antibiotic resistance among the pathogens that cause these infections [3–6]. The primary objective of national hospital infection programmes is to promote surveillance by providing a uniform approach to surveillance among participating hospitals and to offer country-specific data on nosocomial infections. Surveillance of nosocomial BSIs is the cornerstone of prevention and control for each participating hospital [7,8], and nationally aggregated data make international comparisons possible [9,10]. However, few data on nosocomial infections, including the clinical characteristics and the causative agents of these infections, have been collected through surveillance programmes in Japan.

The Infection Prevention and Control Conference for National and Public University Hospitals was organized in 2000 to improve the levels of infection control in Japan by developing new guidelines for infection control that are suitable for the Japanese medical system and by performing surveillance for nosocomial infections. At this conference, some sectional meetings, including surveillance groups, were organized. In the present article, we report the first results from the analysis of the combined data from the 21 hospitals that participated in the surveillance programme for nosocomial BSIs during 2008–2012. This study was conducted to assess the epidemiological features of nosocomial BSIs in Japan.

Materials and Methods

Study design

This study was performed in 22 of the Japanese university hospitals that participated in the Infection Prevention and Control Conference for National and Public University Hospitals; a total of 42 national university hospitals participated in this group in 2008. The surveillance was prospective and hospital wide, covering all patients admitted to the hospitals from April 2008 to March 2012. The data were tallied according to the fiscal year, which begins in April and ends in March. There were two types of surveillance that could be selected by each participating university: (i) surveillance using the microbiological results of blood cultures and/or (ii) surveillance of the clinical characteristics of nosocomial BSIs caused by six pathogens (*Staphylococcus aureus*, *Enterococcus* spp., *E. coli*, *Klebsiella* spp., *Pseudomonas aeruginosa* and *Candida* spp.). These six pathogens represent the major cause of bloodstream infections in Japan, according to the report on Japanese nosocomial infections surveillance performed by the Ministry of Health, Labour and Welfare of Japan (http://www.nih-janis.jp/index.asp, September 2012). Coagulase-negative staphylococci were omitted because the rate of solitary blood culture sets was thought to be high in Japan, and therefore, the actual incidence of BSIs was considered to be too difficult to calculate in this study. Clinical information and microbiological data were recorded by local infection control practitioners on a standardized case record form and entered into a common database that was set up for the study. For this study, any positive blood culture obtained >48 h after admission was considered to be indicative of nosocomial infection, provided that the same organism had not been previously isolated from the patient.

Surveillance of the microbiological results of blood cultures. For this analysis, the number of blood culture sets taken, the rates of multiple blood culture sets performed on the same day, the number of BSIs caused by the six major pathogens and the number of BSIs caused by resistant isolates were counted. Each blood sample collected by a separate venipuncture, regardless of how the sample was apportioned, was defined as one set. The rate of multiple culture sets was calculated as follows: (total number of blood culture sets−total number of solitary blood culture sets)/total number of blood culture sets × 100 (%)).

Surveillance of the clinical characteristics of nosocomial BSIs due to the six major pathogens. The routinely collected data included the patient's age, sex and location at the onset of the BSI (ICU vs. non-ICU ward), clinical procedure performed at the onset of the BSI, predisposing clinical conditions, the source of secondary BSIs, and the outcome during hospitalization (i.e. crude mortality). Predisposing clinical conditions that were routinely recorded included neutropenia (defined as an absolute neutrophil count <500 cells/μL), peritoneal dialysis or haemodialysis, and/or the presence of intravascular catheters.

Incidence

To calculate incidence rates, we collected admission data from the participating hospitals. The incidence rates of nosocomial BSIs caused by the six pathogens were calculated as the number of BSIs per 1000 patient-days. To calculate the number of blood culture sets taken, we determined the number of beds in each participating hospital. According to the guidelines for blood cultures, the optimal numbers of blood culture sets should be 103–188 per 1000 patient-days [11]. However, the average numbers of hospitalization days differ among countries; for example, the average number of hospitalization days in the United States was reported to be 4.9 days, whereas this number was 18.2 days in Japan (http://www.oecd.org/health/healthpoliciesanddata/oecdhealthdata2012.htm). Thus, to compare the number of blood culture sets in our study with this previous report, the number of blood culture sets taken was measured per bed.

Microbiological methods

Each participating hospital laboratory detected growth in blood cultures, identified organisms, and performed susceptibility testing. The identification of blood isolates and susceptibility testing were performed with the routine methods in use at the affiliated laboratories. The data from all hospitals were used for the analysis.

Results

Number of blood culture sets taken and the rate of multiple blood culture sets

Seventeen hospitals participated in the surveillance of microbiology results (average, 766 beds; range, 562–1240). The average number of blood culture sets taken per bed increased from 4.07 per bed (range, 2.00–6.83) in 2008 to 5.36 per bed (range, 2.44–7.34) in 2012. The number of blood culture sets per 1000 patient-days also increased from 12.3 to 15.4, and the average rate of multiple blood culture sets increased significantly from 29.9% (range, 6.3–77.2%) to 50.0% (range, 21.7–77.7%) during this time (Fig. 1).