American Journal of Infection Control 42 (2014) 970-5

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Major article

Clinical effect of a multidisciplinary team approach to the initial treatment of patients with hospital-acquired bloodstream infections at a Japanese university hospital

Hitoshi Tsukamoto BS [a,b,*], Takashi Higashi MS [a], Toshiaki Nakamura PhD [a], Ryoichi Yano PhD [a], Yukio Hida PhD [b,c], Yoko Muroi MS [b], Satoshi Ikegaya MD, PhD [b,d], Hiromichi Iwasaki MD, PhD [b], Mikio Masada PhD [a]

[a] Department of Pharmacy, University of Fukui Hospital, Fukui, Japan
[b] Infection Control and Prevention, University of Fukui Hospital, Fukui, Japan
[c] Clinical Laboratory, University of Fukui Hospital, Fukui, Japan
[d] First Department of Internal Medicine, Faculty of Medical Sciences, University of Fukui, Fukui, Japan

Key Words:
Infection control team
Appropriate antimicrobial therapy
Mortality

Background: Hospital-acquired bloodstream infections (BSIs) are significant causes of mortality, and strategies to improve outcomes are needed. We aimed to evaluate the clinical efficacy of a multidisciplinary infection control team (ICT) approach to the initial treatment of patients with hospital-acquired BSI.

Methods: A before–after quasiexperimental study of patients with hospital-acquired BSI was performed in a Japanese university hospital. The ICT provided immediate recommendations to the attending physician about appropriate antimicrobial therapy and management after reviewing blood cultures, Gram's stain, final organism, and antimicrobial susceptibility results.

Results: The sample included 469 patients with hospital-acquired BSI (n = 210, preintervention group; n = 259, postintervention group). There were no significant differences between the groups in background or microbiologic characteristics. The 30-day mortality was significantly lower and significantly more patients received appropriate antimicrobial therapy in the postintervention group (22.9% vs 14.3%; $P = .02$ and 86.5% vs 69.0%; $P < .001$, respectively). Multivariate analysis confirmed that the ICT intervention was significantly associated with appropriate antimicrobial therapy (odds ratio, 2.22; 95% confidence interval, 1.27-3.89) and 30-day mortality (odds ratio, 0.49; 95% confidence interval, 0.25-0.95).

Conclusions: A timely multidisciplinary team approach decreases the delay of appropriate antimicrobial treatment and may improve HABSI patient outcomes.

Hospital-acquired bloodstream infections (BSIs) are a major cause of morbidity and mortality in hospitalized patients. Moreover, increased hospital mortality is related to inappropriate initial antimicrobial treatment of infections, particularly of BSI,[1] and the timing of antimicrobial administration influences the outcome of many infections.[2] Increasing antimicrobial resistance has resulted in fewer treatment options and has made the selection of empirical therapy more difficult. Habitual use of the same antimicrobial regimen for all patients with suspected significant bacterial infection may increase the rates of inadequate coverage and microbial resistance.

To choose an appropriate antimicrobial regimen, information regarding prior antimicrobial agent use, prior isolation of resistant pathogens, hospital-based antibiograms, and surveillance data are required.[3] In addition, consultation with an infectious diseases physician (IDP) is associated with increased adherence to evidence-based treatment of BSI.[4] In Japan, few hospitals have infectious diseases departments and do not routinely consult about patients with BSI.

We implemented a hospital-wide, multidisciplinary infection control team (ICT) intervention to determine the appropriate initial therapy for patients with BSI. The ICT consisted of 2 IDPs, a clinical pharmacist (ie, a board-certified infection control pharmacy specialist), a microbiology technologist, and an infection control nurse (ICN). The objective of our study was to assess the effect of the multidisciplinary ICT intervention on the clinical outcomes of hospitalized patients with hospital-acquired BSI, including

* Address correspondence to Hitoshi Tsukamoto, BS, Department of Pharmacy, University of Fukui Hospital, 23-3 Matsuokashimoaizuki, Eiheiji-cho, Yoshida-gun, Fukui 910-1193, Japan.
E-mail address: tsuka@u-fukui.ac.jp (H. Tsukamoto).

Conflicts of interest: None to report.

0196-6553/$36.00 - Copyright © 2014 by the Association for Professionals in Infection Control and Epidemiology, Inc. Published by Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.ajic.2014.05.033

mortality, length of stay (LOS), and BSI relapse. In addition, the effect of appropriate antimicrobial therapy was evaluated.

MATERIALS AND METHODS

Study design, setting, and sample

This single-center, before–after quasiexperimental study was performed at the University of Fukui Hospital, a 600-bed secondary- and tertiary-care university hospital in Fukui, Japan. This study was approved by the institutional review board of the Faculty of Medical Sciences, University of Fukui. Informed consent was not obtained from individual patients because the procedures of the ICT constituted routine clinical practice, and only anonymous data were analyzed.

All hospitalized adult patients with hospital-acquired BSI during the preintervention (April 1, 2010, to September 30, 2011) and postintervention (October 1, 2011, to March 31, 2013) periods were included. Patients were excluded for the following reasons: age $<$ 18 years, discharge from hospital before the blood cultures became positive, and polymicrobial BSI.

Data collection

The following data were recorded for each patient: age; sex; body weight; underlying disease; intensive care unit stay at the onset of BSI; neutropenia (defined as an absolute neutrophil count $<$ 500/mm^3); presence of a central venous catheter (CVC); prior surgery (within 30 days before BSI); administration of immunosuppressant agents, corticosteroids, or antineoplastic chemotherapy (within 30 days before BSI); source of BSI; time to blood culture positivity (TTP)[5]; recurrence within 30 days of antimicrobial therapy completion; and LOS after the onset of BSI. In the event of repeated episodes of BSI in the same patient, only the first episode was included in the analysis. All patients were followed until death, hospital discharge, or recovery from infection. All-cause outcomes were recorded as survival or death at 7, 14, and 30 days after BSI onset.

The following comorbid conditions were recorded: diabetes mellitus, solid tumors, hematologic malignancy, liver cirrhosis, chronic renal failure, collagen disease, chronic pulmonary disease, and cardiovascular disease. The Charlson comorbidity index[6] and Pitt bacteremia score[7] were measured to assess illness severity at the time of BSI onset. A central microbiology laboratory was responsible for the management of all clinical specimens.

Preintervention

Before 2011, Gram's stain results were reported by telephone from the microbiology technologist to the attending physician when the automated blood culture system detected growth. However, the attending physician was not contacted when final organism identification and antimicrobial susceptibility results became available. Therefore, all BSI management, including the selection of the antimicrobial regimen, was determined by the attending physician.

Intervention

Beginning in October 2011, all positive blood culture results were reviewed daily by the ICT. The ICT pharmacist was immediately informed by telephone of the Gram's stain results by a microbiology technologist when the automated blood culture system detected growth. The ICT pharmacist immediately reviewed the patient's medical chart (primary review) for background information, including renal and liver function, prior antimicrobial agent use, prior isolation of resistant pathogens, and presence of intravascular devices, and noted the relevant information on a standardized data collection form. The ICT pharmacist then provided a recommendation directly to the attending physician regarding appropriate antimicrobial therapy (eg, route, choice, dose, and dosing schedule) based on hospital-based antibiograms, Gram's stain findings (ie, gram-positive cocci, chain cocci, diplococci, gram-negative rods, or yeast-like fungi), and information obtained from the medical chart. The content and validity of all recommendations were reevaluated at a daily meeting of core members, including the IDP (second review), who provided clinical and decision-making support on complex cases, aiding with feedback and communication to attending physicians. Furthermore, ward clinical pharmacists were extensively used to assist in the ICT intervention.

When the final organism and its antimicrobial susceptibility were identified, the ICT contacted the attending physician and discussed streamlining of the initial antimicrobial treatment or evidence-based management (third review) (Fig 1). When the ICT judged that a specialist follow-up was required, the ICT recommended formal IDP consultation. The ICT interventions were completed Monday to Friday between 8:30 AM and 6:30 PM. After 6:30 PM, the electronic log was reviewed during the next business day. The attending physician was not required to follow the ICT recommendations and was responsible for all final decisions.

We recorded the number of recommendations for each patient and the number of those recommendations accepted by the attending physician. The recommendations were classified as choice of antimicrobial agents; dosing adjustment, including therapeutic drug monitoring; streamlining of antimicrobial therapy; management strategies other than antimicrobial therapy; and formal IDP consultation. There could be $>$ 1 recommendation per patient.

Definitions

Clinically significant BSI was defined as $\geq$ 1 positive blood culture together with clinical features compatible with systemic inflammatory response syndrome. If the isolate was potentially skin contamination, only patients with $\geq$ 2 positive blood cultures plus systemic inflammatory response syndrome were included. A positive blood culture obtained $>$ 48 hours after hospital admission was defined as hospital-acquired. The day of sampling the first positive blood culture was considered to be the date of BSI onset (day 0). Catheter-related BSI was considered when clinical signs of catheter infection and/or positive culture results from the catheter tip were present with no evidence of an alternative source of BSI. The source of secondary BSI was determined from clinical, radiologic, and microbiologic evidence, using the Centers of Disease Control and Prevention criteria.[8] Primary BSI was diagnosed when there was no identification of infection focus. Relapse of BSI was defined as recurrence of the infection due to the same pathogen occurring during the 30 days after the completion of antimicrobial therapy. Initial antimicrobial therapy was considered to be appropriate if the antimicrobial agents, which were administered within 48 hours after the collection of the blood culture sample, included at least 1 antibiotic agent that was active in vitro and if the dosage and route of administration were in accordance with published guidelines (ie, the Sanford Guide to Antimicrobial Therapy). Only formal written consultation requests from the attending physician were considered to be formal IDP consultation.[9]

Statistical analyses

Demographic, microbiologic, and outcome variables were compared between the preintervention and postintervention