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Clinician response time for positive blood culture results in a pediatric ICU

Mary Jo C. Grant, CPNP-AC, PhD, FAAN *, Jared Olson, PharmD, BCPS, Alex Gerber, AS

Primary Children's Hospital, 100 North Mario Capecchi Drive, Salt Lake City, UT 84113, USA

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ABSTRACT

Introduction: Positive blood cultures guide clinicians to prescribe specific therapy based on in vitro susceptibility. Delays in appropriate antibiotic therapy increase morbidity associated with positive blood culture.
Hypothesis: Time from clinician notification of positive blood culture to administration of targeted antimicrobial therapy should follow Surviving Sepsis guidelines.
Methods: Study setting was a 44 bed pediatric ICU. Data were extracted from the pharmacy database and the medical records of pediatric ICU patients with positive blood culture. Source, time blood culture was obtained, time of clinician notification of positive result, and administration time of first dose of new antimicrobial was captured.
Results: 174 positive blood cultures from 111 PICU patients were examined. Antimicrobials were changed after the positive culture in 51 (49%) patients. The new antibiotic was administered in an average of 6 h 35 min from clinician notification.
Conclusions: We demonstrated a delay from clinician notification of positive culture to new antibiotic administration.

Introduction

Rapid diagnosis of infection, antibiotic dosing and antibiotic optimization are some of the most relevant issues in the care of the critically ill patient.[1] Recent progress has been made in the implementation of effective antimicrobial stewardship and infection control programs. The Surviving Sepsis Campaign is a partnership of the European Society of Intensive Care Medicine and the Society of Critical Care Medicine which created recommendations intended to provide guidance for the clinician caring for a patient with severe sepsis or septic shock.[2] The Surviving Sepsis Campaign recommends reassessing the antimicrobial regimen daily to optimize efficacy, prevent resistance, avoid toxicity, and minimize costs.[3] Although restricting the use of antibiotics, and particularly broad-spectrum antibiotics, is important for limiting superinfection and for decreasing the development of antibiotic resistant pathogens, patients with severe sepsis or septic shock warrant broad-spectrum therapy until the causative organism and its antibiotic susceptibilities are defined.

The administration of inadequate antimicrobial treatment to critically ill patients with bloodstream infections is associated with greater hospital mortality compared with suitable antimicrobial treatment of bloodstream infections.[4] Clinical efforts should be aimed at reducing the administration of inadequate or inappropriate antibiotic therapy to hospitalized patients with bloodstream infections, especially patients infected with antibiotic-resistant bacteria and Candida species.[5]

The antimicrobial regimen should be reassessed daily for potential de-escalation and once the causative pathogen has been identified, the most appropriate antimicrobial agent that covers the pathogen and is safe and cost-effective should be selected. Narrowing the spectrum of antimicrobial coverage will reduce the likelihood that the patient will develop superinfection.[6] Antimicrobial use can be improved in ICU settings by shortening the duration of treatment or antibiotic prophylaxis without affecting patient outcome.[7] De-escalation could be one of several effective strategies for a more appropriate empirical therapy.[8]

The coexistence of increasing pathogenic antibiotic resistance has contributed to a heightened need for timely clinician responsiveness to a patient newly diagnosed with bloodstream infection. Delays in administration or inappropriate antibiotic therapy may alter a patients' clinical course. Timely antibiotic administration is paramount in patients diagnosed with bloodstream infection.

* Corresponding author. Tel.: +1 801 662 2442.
E-mail address: Maryjo.grant@imail.org (M.J.C. Grant).

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We performed a retrospective data review to determine the frequency of antibiotic modification after clinician notification of a positive blood culture. We also sought to determine the length of time from clinician notification of positive blood culture to administration of a new antibiotic.

Methods

Study patients

This retrospective study was conducted in a 242-bed university-affiliated pediatric tertiary care medical center. The 44-bed combined cardiovascular, medical and surgical pediatric intensive care unit (PICU/CICU) has 2400 admissions per year and is a "closed" unit; care is supervised by board-certified pediatric intensivists.

All consecutive patients admitted to the PICU and CICU between 1/1/2011 and 8/28/2012 were included. Positive blood cultures obtained during the 20 month study period from the PICU/CICU were analyzed. Data were extracted from a pharmacy database and patient medical records. Blood culture source, time blood culture was obtained, time of clinician notification of positive result, organism, and administration time of all antimicrobials were analyzed. Institutional Review Board approval was obtained and a waiver of consent granted.

Antibiotic administration

Antibiotic prescription was not protocolized in our unit. Therefore the decision to start antibiotics, antibiotic choice and duration was at the discretion of the attending physician. Empiric antibiotic therapy was based on patients' characteristics, the severity and location of the infection. Typically, broad-spectrum antibiotics are prescribed in combination after microbiological samples are obtained, when feasible. Broad spectrum antibiotics are usually prescribed in combination.

Microbiology samples are read continuously through an automated system. Any positive microbiology culture result is phoned to the nurse practitioner or physician caring for that patient. The date, time and name of clinician notified are recorded in the microbiology database. Further identification of the organism and antibiotic susceptibility is completed for all positive cultures.

The decision to change antimicrobials after positive blood culture frequently occurs after identification of the organism. Microbiologic data is generally available 24 h after the culture initially becomes positive. For this reason positive cultures with subsequent modification in antimicrobials less than or greater than 24 h were analyzed separately. Definitions are included in Table 1.

Statistical analysis

Positive blood cultures from the study period were analyzed. Data were organized into an electronic spreadsheet arranged by dates and times of blood samples taken, physician notification of positive bacterial growth, and antibiotic administrations and changes. Once organized, changes in antibiotics were separated into >24 h and <24 h after clinician notification of positive bacterial growth to estimate which changes were in response to new organism susceptibilities. We present descriptive statistics of categorical variable and continuous variables as a mean.

Results

During the study period 3607 PICU and 1180 CICU patients were admitted. A total of 174 positive blood cultures were reviewed, 111 met the definition of unique blood culture, with 65% of the cultures drawn from PICU patients (Fig. 1). The majority of the unique positive blood cultures were on antibiotics at the time of positive notification. Antibiotics were changed within 24 h of positive notification and indication of susceptibilities in 30 of the 111 patients unique positive cultures (Fig. 2).

Clinicians averaged 6 h 35 min (range 69–1293 min) from notification to administration of new antibiotic in those patients whom antibiotics were changed < 24 h after diagnosis of positive blood culture (Fig. 3). There was no significant difference between PICU and CICU response time. There was a considerable difference between response times by time of day, with a longer delay during the night shift (633 min night shift vs. 247 min day shift). The majority of infections were coagulase-negative staphylococci (Table 2).

Table 1
Definition of terms.

Unique patient culture	From an individual patient, >24 h apart, not representing consecutive positive cultures
New antimicrobial	Any new antimicrobial added after clinician notification of a positive culture
Clinician notification	The recorded time of microbiology department verbal notification of positive culture to a Nurse Practitioner or Physician
Administration of new antibiotic	Administration time recorded by the bedside nurse using an electronic scan system
De-escalation therapy	Either a switch to a narrower spectrum agent, or the reduction in the number of antibiotic agents, or the early discontinuation of antibiotic therapy on the emergence of bacterial resistance

Discussion

We demonstrated a greater than 6 h delay from clinician notification of positive culture to new antimicrobial administration in critically ill pediatric patients. This delay may represent a critical time period when a patient with positive blood culture is not receiving appropriate therapy.

Several studies have confirmed the mortality benefit associated with appropriate antimicrobials in patients with severe infections due to Gram-negative and Gram-positive bacteria.[4,9,10] Failure to initiate appropriate therapy promptly (i.e., therapy that is active against the causative pathogen) has adverse consequences on outcome in adults. Zaragoza et al[11] found almost 23.5% of critically

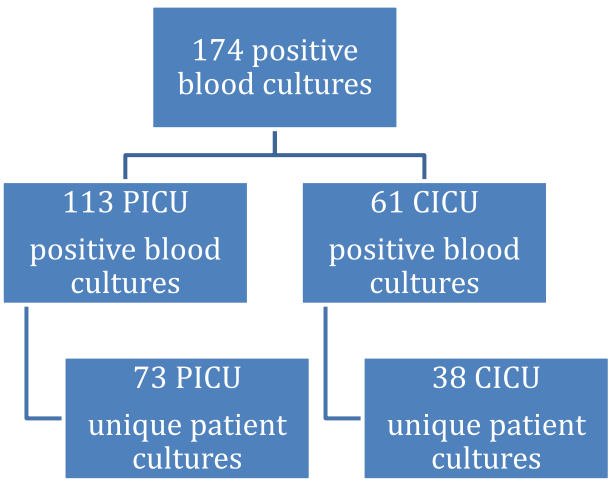

Fig. 1. Baseline inclusion criteria.