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Best Clinical Practice

BEST CLINICAL PRACTICE: BLOOD CULTURE UTILITY IN THE EMERGENCY DEPARTMENT

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☐ **Abstract—Background: Bacteremia affects 200,000 patients per year, with the potential for significant morbidity and mortality. Blood cultures are considered the most sensitive method for detecting bacteremia and are commonly obtained in patients with fever, chills, leukocytosis, focal infections, and sepsis. Objective: We sought to provide emergency physicians with a review of the literature concerning blood cultures in the emergency department. Discussion: The utility of blood cultures has been a focus of controversy, prompting research evaluating effects on patient management. Bacteremia is associated with increased mortality, and blood cultures are often obtained for suspected infection. False-positive blood cultures are associated with harm, including increased duration of stay and cost. This review suggests that blood cultures are not recommended for patients with cellulitis, simple pyelonephritis, and community-acquired pneumonia, because the chance of a false-positive culture is greater than the prevalence of true positive cultures. Blood cultures are recommended for patients with sepsis, meningitis, complicated pyelonephritis, endocarditis, and health care–associated pneumonia. Clinical prediction rules that predict true positive cultures may prove useful. The clinical picture should take precedence. If cultures are obtained, two bottles of ≥7 mL should be obtained from separate peripheral sites. Conclusions: Blood cultures are commonly obtained but demonstrate low yield in cellulitis, simple pyelonephritis, and community-acquired pneumonia. The Shapiro decision rule for predicting true bacteremia does show promise, but clinical gestalt should take precedence. To maximize utility, blood cultures should be obtained before antibiotic therapy begins. At least two blood cultures should be obtained from separate peripheral sites.** © **2016 Elsevier Inc. All rights reserved.**

☐ **Keywords—bacteremia; blood cultures; blood stream infection; cellulitis; sepsis; pneumonia; pyelonephritis**

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INTRODUCTION

Approximately 200,000 patients are affected by bacteremia per year, with 10 cases per 1000 hospital admissions (1–4). True blood stream infections can cause significant mortality, ranging from 14% to 37%, with the upper range of mortality seen in intensive care unit (ICU) settings (1,4,5). Blood stream infections, or bacteremia, generally result from endocarditis, an infected central venous catheter, primary bacteremia, pneumonia, severe abscess, osteomyelitis, cellulitis, intra-abdominal infection, and urinary tract infections (1–3,6). Bacteremia does have high mortality, and because of the dangers of undertreatment, many physicians order cultures liberally.

Blood cultures are generally considered to be the most sensitive method for the detection of bacteremia and are thought to be useful in certain diagnoses and critically ill patients (1,2,6). These cultures are commonly obtained in patients with fever, chills, leukocytosis,

focal infections, sepsis, or suspected endocarditis. In the emergency department (ED), blood cultures are often ordered for patients with suspected infection, but the literature has questioned the utility of these cultures. Many guidelines do not state when blood cultures should be obtained, though the Infectious Disease Society of America (IDSA) provides recommendations for culture collection in several infections (7–13). Obtaining blood cultures over the past decade has been tied to core measures and payments, introduced by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and Centers for Medicaid and Medicare Services (CMS) (14–16).

Bacteremia is defined by a true-positive blood culture and, as discussed, is associated with mortality. However, half of these cultures are actually contaminants (6,17). Organisms that are inoculated into culture bottles at the time of blood culture collection result in contamination. Only 4% to 7% of cultures are truly positive, and the false-positive blood cultures are not without potential risk and harm (4,6,18,19).

DISCUSSION

The utility of blood cultures has been a focus of controversy, prompting ample research to evaluate their effect on patient management in recent years. Many of these studies suggest that blood cultures rarely alter treatment and may be associated with harm. False-positive results can lead to inappropriate antimicrobial use, increased cost, and longer durations of hospital stays (17,18). Bates et al. noted that patients with false positive blood cultures have an increased duration of hospital stay of 4.5 days and an increased cost of $4385 per episode of false-positive bacteremia (17,18). Other studies found similar results, with an increased duration of stay and cost (1–6).

Positive Cultures

Bacteremia consists of two patterns: intermittent and continuous. Intermittent is most common and means bacteria are present in the blood only at certain times, usually after the manipulation of infected tissues, instrumentation, or bacterial infections (6,20). On the other hand, continuous refers to persistent bloodstream infection from endovascular infection. These infections include grafts, endocarditis, or infected internal hardware (6,20).

Other types of infection with bacteremia include extravascular infections, such as pneumonia and urinary tract infection, and intravascular infection with a source located along the vasculature, such as infective endocarditis or infected aortic endovascular graft (20).

Blood Culture Yield

The yield of blood cultures has been evaluated in multiple studies in several different patient populations, with each study questioning the utility of these cultures. A study published in 2006 shows a useful culture rate of 2.8% (6/218) and suggests eliminating blood cultures in immunocompetent patients with common illnesses, such as urinary tract infection, community-acquired pneumonia (CAP), and cellulitis (21). Another study published in 2007 shows that of 2210 blood cultures, only 132 (6%) yielded positive growth, with 4 (0.18%) resulting in altered patient management (22). A study conducted in an ED found positive cultures in 9.7% of patients, with only 3.4% truly positive (23).

Pneumonia

Pneumonia is a common infection, accounting for serious morbidity and mortality, and is the sixth leading cause of death and leading infectious cause of death in the United States (8,24–26). The most common form is CAP, defined as pneumonia in a nonhospitalized patient with none of the following: intravenous therapy, wound care, intravenous chemotherapy $\leq$30 days, residence of a nursing or long-term care facility, hospitalization for $\geq$2 days within the previous 90 days, or attendance at a hospital or hemodialysis clinic within $\leq$30 days. Health care–associated pneumonia (HCAP) is defined by the presence of one of those factors and is associated with a greater risk of multidrug-resistant bacteria when compared to CAP. Hospital-acquired pneumonia refers to pneumonia affecting a patient 48 to 72 hours after admission to the hospital. Pneumonia is a common infection, with an incidence of 4 million cases per year (8,24–27).

Blood cultures are commonly argued for in patients with pneumonia after a 1997 study by Meehan et al. that found an association between collecting blood cultures and decreased mortality (28). However, multiple confounders were present in the study, and no attempt was made to control for these variables. Patients with blood cultures obtained within 24 hours of hospital admission received other aggressive treatments, which likely affected mortality rates, making it difficult to ascertain the effect of blood cultures on patient management. Blood cultures were previously recommended in patients with CAP by the IDSA if the following are present: admission to an intensive care unit, cavitary infiltrates are present on imaging, leukopenia, chronic severe liver disease, asplenia, pleural effusion, positive pneumococcal urinary antigen test, and active alcohol abuse (8). However, these are no longer recommended for admitted patients with CAP per IDSA, CMS, and