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Diagnostic Stewardship Part II: Understanding indications for collecting blood cultures for hospitalized adult patients

Introduction

Our May 2017 DASON Newsletter discussed appropriate indications for urine cultures and *C. difficile* PCR testing. This newsletter is focused on appropriate indications for obtaining blood cultures in hospitalized adult patients. This topic is important because obtaining unnecessary blood cultures leads to increased costs, overuse of antibiotics, additional unnecessary testing and may cause patient harm. For example, false-positive blood cultures may lead to unnecessarily long courses of intravenous antibiotics and unwarranted removal of vascular devices such as ports or pacemakers and, drug toxicity. Furthermore, it is sometimes difficult to determine if an isolate is a contaminant or a pathogen even if current NHSN definitions are applied or standard clinical judgment is utilized. This in turn may lead to spurious diagnoses that are erroneously reported as hospital-acquired conditions (HAC) that in turn incur financial penalties to your local hospital.

Contributing Factors to Inappropriate Ordering of Blood Cultures

Timely initiation of appropriate antibiotic treatment for bacteremia is critical to reducing infection-related morbidity and mortality (ranging from 14-37%).[1] Although only 4-7% of blood cultures are positive, a substantial proportion (30-50%) of these "positive cultures" reveal normal skin flora and thus are likely or possible contaminants.[1] Physicians caring for patients with suspected bacteremia or sepsis face two everyday dilemmas: First, despite their concerns about making timely diagnosis and treating patients with possible bloodstream infection, current guidelines for the diagnosis and treatment of sepsis do not explicitly state when to obtain blood cultures. Second, because blood cultures should be obtained prior to initiation of empiric therapy, a decision to obtain or forgo cultures often must be made before important clinical information related to the presence of an actual infection are available.

Indications for Blood Cultures

We advise clinicians to obtain blood cultures using the clinical indications outlined in Table 1. Repeat blood cultures after a prior positive result are indicated in some specific scenarios but not others (Table 2).[2] Isolated fever or leukocytosis are in themselves not always indications for obtaining blood cultures in many hospitalized patients.[1]

Table 1. Clinical Indications for Initial Blood Cultures

Temperature > 103°F	**2 or more of the following:**
Known or suspected: Neutropenia Endocarditis Sepsis Septic arthritis Osteomyelitis Peritonitis Pneumonia Severe skin/soft tissue infection Meningitis	Temperature 100.4-102.9°F
	SBP < 90
	WBC > 18 or < 4
	Rigors
	Age > 65
	Immunosuppression
	Intravascular catheter
	New lab abnormalities (e.g. low platelets, acute kidney injury, left shift in WBC)

SBP, systolic blood pressure; WBC, white blood cells

We do not recommend routine culturing of critically ill patients who are afebrile (e.g., patients on cooling protocols and those receiving ECMO or CVVHD). Rather, clinical judgment coupled with an assessment of hemodynamic status, laboratory test results, imaging studies and physical examination should be used to determine the need for blood cultures in these patients. Finally, we advise against routinely obtaining blood cultures in patients with central venous catheters at the time of their admission to a unit unless they have valid clinical indications for blood culture. Blood cultures obtained from patients without bona fide indications for

such testing for have little or no diagnostic value and are far more likely to reveal a contaminant than a pathogen.

Table 2. Indications for Repeat Cultures after Initial Positive Blood Cultures
Known or suspected endocarditis
Staphylococcus aureus bacteremia
Candidemia
Persistent fever or leukocytosis > 72 hours after initiation of appropriate therapy
Known or suspected site of infection with limited antimicrobial penetration
Presence of vascular grafts, intravascular lines, or cardiac devices
Presence of highly resistant pathogen(s)
Unknown source for initial bacteremia

One set of blood cultures is inadequate as a single set of cultures does not allow clinicians to determine if a positive culture containing normal skin flora represents true bacteremia or a false-positive result. Two or three sets of blood cultures obtained from separate venipunctures are normally adequate to diagnosis bacteremia. In general, repeat blood cultures are warranted after initial blood cultures are negative only when a patient's clinical status or condition has changed (worsened) and there is either a worsening or other significant change in clinical status. Alternate techniques for detecting fungemia or bacteremia such as the use of special media or PCR-based testing are sometimes useful in patients who have epidemiologic or clinical clues to an uncommon bacterial or fungal pathogen.

The technique of obtaining blood cultures is critically important. Careful and correct skin preparation with a disinfectant such as topical chlorhexidine and alcohol or tincture of iodine and alcohol reduces the risk of pseudo-bacteremia due to skin contaminants.[3] Personnel who obtain blood cultures should have special training on how to avoid skin contamination during venipunctures, how to properly inoculate blood into collection bottles, and the need to obtain the proper amount of blood to avoid false-negative results. Blood cultures should not be drawn through intravenous catheters at the time of their insertion and only drawn from existing vascular lines when two separate peripheral venipunctures cannot be obtained. In such circumstances at least one peripheral venipuncture should be utilized to allow determination of whether a positive result is a contaminant or a true pathogen. Because of the complexity and importance of following proper technique and protocols for collecting blood specimens for cultures, the use of dedicated phlebotomy personnel to obtain blood cultures is preferred is this is typically associated with substantially lower rates of false-positive blood cultures.

Although special blood collection devices that divert the first 1-2 ml of blood into a separate receptacle can greatly reduce the chance of false-positive blood cultures due to skin flora, such devices are not currently available in most hospitals.

Summary and Recommendations:

The decision to obtain or forgo collection of blood cultures requires a thorough and working knowledge of the indications discussed above. However, this knowledge has to be coupled with clinical judgment and an awareness of numerous clinical findings and settings that can be alternate clues to the presence of bacteremia. Lack of knowledge of the preceding standard indications and subtle clues to the presence of bacteremia can lead to over or under utilization of this potentially life-saving and crucially important clinical test. Finally, proper technique, proper selection of the site of blood collection and obtaining a proper volume of blood is crucial to avoid both over and under-diagnosis of bacteremia and their respective attendant consequences.

References:

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