Taking blood for culture

Introduction

Blood cultures are a common and useful investigation. Positive blood cultures can help in confirming a clinical diagnosis, localizing the site of infection and rationalizing antibiotic therapy. This review examines some of the issues regarding the optimal methods of blood culture collection. For the purposes of this review, a blood culture is defined as the blood taken at one venepuncture, irrespective of how many bottles are inoculated.

Timing of blood cultures

Traditionally blood cultures have been taken at the time of pyrexia.

A major review of bacteraemia in the 1950s suggested that the optimal time for taking blood cultures is during the hour before the expected chill or fever, if this can be predicted. This suggestion was based on reports which showed a time lag between the onset of bacteraemia and the subsequent rigor or fever, and noted that blood taken during the fever was often sterile (Bennett and Beeson, 1954).

Predicting fevers in a clinical setting clearly poses practical difficulties, except perhaps in a stable patient undergoing investigation for pyrexia of unknown origin. Clearly, in a septic patient, investigations should be completed promptly so that antimicrobial therapy can be started. When time allows, more than one set of cultures should be taken in order to increase the yield, as will be seen below. When multiple cultures are sent, there is no good evidence that a time interval between cultures increases the yield, as demonstrated in a study by Li et al (1994).

It is important to note that some patients, for example the elderly or immunosuppressed, may not be febrile at the time of presentation with sepsis.

Suspected endocarditis

The bacteraemia in endocarditis is continuous rather than intermittent, and the timing of blood cultures appears to be unimportant (Hawkey and Lewis, 2004). Most cases of endocarditis are culture positive, provided the cultures are taken before the administration of antibiotics (Mandell et al, 2005). Multiple sets are taken to help determine whether the organisms isolated represent true pathogens or contaminants.

How many bottles?

A study from 2004 found that 95.7% of bloodstream infections were detected when three blood cultures were taken, compared to 65.1% when only one culture was taken. The yield falls rapidly when more than three cultures are taken (Cockerill et al, 2004).

Skin preparation

Contamination of blood cultures with skin flora is common, causes diagnostic problems, and increases the cost and length of stay for hospitalized patients (Calfee and Barry, 2002).

Many doctors use 70% isopropyl alcohol swabs ('Sterets') in isolation for skin preparation before taking blood cultures. In a brief questionnaire of consultant microbiologists in Wales, all of the responses given advised the use of Sterets, with the added emphasis on ensuring the skin has dried (i.e. waiting 30–45 seconds) before sampling.

Many previous reviews and textbooks recommend different approaches, including the sequential use of alcohol followed by iodine. A study from 1990 comparing cleaning with alcohol and cleaning with alcohol followed by povidone-iodine solution failed to show any effect of the latter procedure on the false positive rate of blood cultures, although the study was underpowered (Shahar et al, 1990). A more recent study detected no differences in contamination rates between tincture of iodine, povidone-iodine, ethyl alcohol and isopropyl alcohol. Again, this study was underpowered (Calfee and Barry, 2002).

In conclusion, there is a suggestion, although no definitive evidence, that using isopropyl alcohol for cleaning in isolation is a reasonable alternative to iodine- or chlorhexidine-based solutions.

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Changing needles

In the past it has been common practice to change the needle on the syringe before the inoculation of blood cultures in order to avoid the potential introduction of contaminating organisms.

The evidence for this approach was unclear. Although several studies before 1995 showed no significant difference in the contamination rates by the single or double needle techniques, a meta-analysis in 1995 suggested a reduction from 3.7% to 2.0% when the double-needle technique was used (Weinstein, 2003).

At present, concerns regarding blood culture contamination have been superseded by the perceived risk of needle-stick injuries of the needle-switch method. This is in keeping with Department of Health advice on the avoidance of needle-stick injuries (Department of Health, 1998). For this reason it is unlikely that there will ever be further studies to determine whether or not this method genuinely decreases contamination rates.

Blood volume

Most reviews and studies recommend taking 20 ml or more of blood per venepuncture from adults to inoculate a set of blood culture bottles (i.e. 10 ml per bottle) (Weinstein et al, 1994; Cockerill et al, 2004). This is because of the frequent paucity of microorganisms in a given blood volume during many bloodstream infections. Many automated culture systems use a vacuum to assist inoculation of the culture bottle. These bottles should be filled until the vacuum expires. BJHM

Conflict of interest: none.

Bennett IL, Beeson PB (1954) Bacteraemia: a consideration of some experimental and clinical aspects. *Yale J Biol Med* **26:** 241–62

Calfee DP, Barry MF (2002) Comparison of four antiseptic preparations for skin in the prevention of contamination of percutaneously drawn blood cultures: a randomized trial. *J Clin Microbiol* **40:** 1660–5

Cockerill FR, Wilson JW, Vetter EA et al (2004) Optimal testing parameters for blood cultures. *Clin Infect Dis* **38:** 1724–30

UK Health Departments (1998) *Guidance for Clinical health Care Workers: protection Against Infection with Blood-borne Viruses; Recommendations of the Expert Advisory Group on AIDS and the Advisory Group on Hepatitis (HSC 1998/063).* Department of Health, Wetherby: 10–11

Hawkey P, Lewis D, eds (2004) *Medical Bacteriology.* 2nd edn. Oxford University Press, Oxford: 28

Li J, Plorde JJ, Carlson LG (1994) Effects of volume and periodicity on blood cultures. *J Clin Microbiol* **32:** 2829–31

Mandell L, Bennett J, Dolin R, eds (2005) *Principles and Practice of Infectious Diseases.* 6th edn. Elsevier Churchill Livingstone, Philadelphia: 895

Shahar E, Wohl-Gottesman B, Shenkman L (1990) Contamination of blood cultures during venepuncture: fact or myth? *Postgrad Med J* **66:** 1053–8

Weinstein MP (2003) Blood culture contamination: persisting problems and partial progress. *J Clin Microbiol* **41:** 2275–8

Weinstein MP, Mirrett S, Wilson ML, Reimer LG, Reller LB (1994) Controlled evaluation of 5 versus 10 millilitres of blood cultured in aerobic BacT/Alert blood culture bottles. *J Clin Microbiol* **32:** 2103–6

KEY POINTS

- If the condition of the patient allows, take two or more sets of cultures before the administration of antibiotics.
- Take a minimum of three sets in suspected infective endocarditis.
- Prepare the skin with an alcohol, chlorhexidine or iodine-based antiseptic.
- Allow the solution to dry before venepuncture.
- Withdraw 20 ml of blood and inoculate equally between two blood culture bottles.
- Do not switch needles before inoculation.