

## EXERCISE 7: BLOOD CULTURE SPECIMEN COLLECTION

Textbook: Chapter 13 Arterial, IV and Special Collection Procedures

Skills: 20 points

Objectives:

1. Differentiate between sterile and antiseptic techniques.
2. Define "septicemia" and "bacteremia".
3. Describe the type of patient who may be a candidate for a blood culture.
4. Discuss the interview process used for patient preparation when drawing blood culture samples especially iodine allergies..
5. State the number of blood culture collections necessary for sufficient recovery of clinically significant microorganisms.
6. List the materials and supplies necessary for collection of a blood culture specimen.
7. Describe the proper procedure for preparing a blood culture site and why this is so important.
8. Describe the product "Chloroprep" and the advantages this has over the traditional site preparation method.
9. Define "false positive" and "false negative" as the terms relate to blood cultures.
10. State two causes of false positive and false negative blood culture results.
11. Discuss when the antibiotic removal device (ARD) bottles are used and how they work.
12. Describe the ISOSTAT blood culture collection system and the purpose for it's use.
13. State the information which must be put on the label of blood culture samples.
14. Describe the different protocols used for the collection of blood cultures for systemic and localized infections and infective endocarditis.
15. Perform a blood culture using proper collection and labeling techniques and with minimal trauma to the patient.

### Discussion

Blood cultures are collected whenever it is suspected that a patient has septicemia. **Septicemia** is a condition when microorganisms (mainly bacteria) circulate and multiply in the patient's blood. Sometimes, during the course of a bacterial infection, bacteremia (bacteria in the blood) may result and become the dominant clinical feature. The patient may have a fever of unknown origin (FUO) and experience fever spikes. It is generally recommended that blood cultures be drawn before and after the fever spike, when bacteria may be most likely present in the peripheral circulation. Blood culture analysis is usually ordered before the initiation of antimicrobial therapy, usually in a series, two to three blood cultures collected at least 1-2 hours apart. The blood culture analysis is used by physicians to rule out or confirm septicemia and/or bacteremia.

### Patient Preparation

Explain to the patient, if he/she is coherent, that the physician has ordered a series of tests and you will have to stick him/her several times at timed intervals. Any additional questions about the procedure needs to be addressed to the physician. Do not volunteer any additional information.

## Collecting the Specimen

Blood is normally sterile, the presence of microorganisms and their products is very serious and can cause death. A blood culture will indicate the severity of an infection and identify the causative organism. Normal values are negative for growth.

It is best to draw one set of aerobic (containing oxygen) and anaerobic (without oxygen) cultures at the time the order is given. Thirty minutes later, a second set of anaerobic and aerobic cultures should be obtained. A request for "**second site**" blood cultures that are obtained concurrently on opposite arms is useful when the physician suspects bacteremia due to a local internal infection. However, a "second site" culture is **not** a very effective tool for **routine** blood culture orders and provides relatively little information that properly spaced, timed blood cultures cannot provide.

Recent reports recommend that in most instances two blood culture sets are sufficient for recovery of significant microorganisms, particularly with the increased blood volume collected. There is greater than 99 percent recovery with only two sets.

## Blood Culture Collection Protocols

Blood culture collection protocols may be set up and designed to detect bacteremia in certain disease state suspected or symptoms that the patient is exhibiting. A commonly accepted protocol for obtaining blood cultures is as follows:

### 1. Systemic and localized infections

- a. Suspected acute sepsis, meningitis, osteomyelitis, arthritis or acute untreated bacterial pneumonia. Obtain two blood culture sets before starting therapy from two separate sites (eg, left and right arms).
- b. Fever of unknown origin (FUO). Obtain two blood culture sets initially; 24 to 36 hours later, obtain two more. More than four sets is not necessary.
- c. Suspected early typhoid fever and brucellosis (rarely seen). Obtain three blood culture sets over 24 to 36 hours.

### 2. Infective endocarditis;

- a. Obtain three blood culture sets at three separate venipuncture sites during the first one to two hours of evaluation and begin antimicrobial therapy; if all are negative 24 hours later, obtain two more sets.
- b. Culture negative endocarditis. Consult with the microbiology department after five negative cultures. Culture negative endocarditis is extremely rare.

## Site Preparation

**The most critical step in collecting a blood culture is the proper cleansing of the site.** Bacteria are normally present on the skin surface. It is **imperative** for quality test results that bacteria is NOT introduced into the specimen being collected. Before the collection of a specimen for blood culture analysis, the selected venipuncture site must be prepared by aseptic technique. Once the site has been prepared **DO NOT REPALPATE!** Repalpating the site will contaminate it. The site is first cleansed with alcohol to remove the

oils and dirt on the skin surface. The site is then painted with a **2 percent tincture of iodine** solution to kill surface skin bacteria. Before any preparation of the site is begun, the patient must be asked about any allergy to iodine. If the patient does have an iodine allergy, the only recourse is to cleanse thoroughly with 70 percent alcohol a second time, some places may also use green soap. The cleansing is done with a circular motion, starting at the site of the puncture and moving in concentric circles outward. The iodine is painted on the area, not flooded over the site. Iodine is an effective antiseptic only if it is allowed to dry before the venipuncture is attempted. The cleansing procedure varies from one laboratory to another.

A new less toxic product called **ChloroPrep** is now available. This is a one-step application of 2% chlorhexidine gluconate and 70% isopropyl alcohol. The solution comes in an ampule attached to a scrubbing sponge. The handle is squeezed to break the ampule and dispense the solution and the site is scrubbed firmly for 30 seconds to disinfect the site. The one step method is quicker and leads to better compliance in preparation of sites for blood culture collection. In theory this should lead to fewer contaminated blood culture collections.

The seals on the bottles are broken off. This seal usually consists of a metal flip off cap. Under the seal is a rubber septum through which the blood is injected. Once the flip off cap is removed, the septum is cleaned with an alcohol pad. The alcohol pad is left on the bottle until just before the blood is injected. The proper amount of blood is drawn with a syringe. The alcohol pad is removed from the bottle cap. Without changing needles, the blood is then injected into the bottles. Always inject the anaerobic bottle **first** to maintain a strict anaerobic environment.

Instead of using a syringe to draw the blood and inoculate the bottles, a butterfly collection set can be used. An adapter can be attached to the end of the butterfly which attaches to the blood culture bottle and directly inoculates the bottle with blood. Each bottle is filled to the proper level of blood. There are also blood culture bottles with long necks that insert into an evacuated needle holder. These are the **preferred methods because they minimize the chance of contamination** due to the blood being drawn directly into the prepared tube. It is **critical** that the tops of the tubes be cleansed prior to collection. When multiple samples are needed **blood cultures are collected first**.

With all blood culture methods, there are some variations in procedure for the phlebotomist. The arm cleansing technique may differ. Some blood culture systems must have the aerobic bottle vented (air added) by the phlebotomist. A variation in procedure does not indicate the laboratory is improper but illustrates variations in manufacturers directions.

## **Blood Culture Collection Systems**

The blood is collected and placed in a bottle containing a solution that enhances the growth of significant microorganisms if they are present. An anticoagulant is also present. If blood cultures are to be collected after antimicrobial treatment has started, the blood culture must be drawn in a special bottle containing a resin solution to inactivate the antimicrobial agent. Antibiotics present in the blood will inhibit bacterial growth. The resin bottle is known as an **antibiotic removal device (ARD)** bottle.

The **Isostat System** is a special blood culture tube system which has a stopper that fits standard blood collection vacuum holders, *lysing and anticoagulating agents, reagents in the tube that inactivate HIV within the normal 60 minute transport and processing time* and containment adapters that help protect the phlebotomists and laboratorians against infection due to aerosols or breakage during centrifugation. After blood is drawn into the tube it is inverted 5 to 6 times.

The blood cells in the tube lyse, the tube is centrifuged in the microbiology laboratory, and the sediment is then inoculated directly on solid culture media to determine if microorganisms are present. Using this tube affords the advantage of faster microbial test results.

## Labeling the Specimen

When labeling blood culture specimens, routine labeling procedures should be followed. In addition, the label should include the site used for collection and the number of the sample in the collection series (eg, R arm, 2nd of 3). Sites are varied throughout the series of blood culture collection to increase the rate of recovering pathogenic bacteria. Consequently, the blood culture specimens should be labeled with the collection site and the sequence in the collection series as a point of reference for the subsequent draw. In addition, the site of collection and the sequence in the collection series may impact the interpretation of the results. Therefore, the information must be available to the technologist and the attending physician.

## Quality Control in Blood Culture Collection

If a blood culture specimen was collected from an improperly prepared site, the specimen may be contaminated with microbial flora of the skin. A positive blood culture that is the result of collection error - and NOT due to pathogens in the patient's bloodstream - is referred to as a "**false positive**".

Contamination of blood culture specimens should be limited to less than 3% (IE, less than 3 out of every 100 positive blood cultures should be the result of contamination during the blood collection procedure). If the microbiology department determines that the contamination rate exceeds 3%, it will investigate. The phlebotomists who collected the contaminated cultures will be identified, and their technique will be evaluated and, if necessary, modified.

If the microorganism recovered is recognized as a common skin contaminant (eg, Staphylococcus epidermidis or Corynebacterium), one might think it could be safely ruled out as the causative organism of the patient's bacteremia. However, in certain conditions, such as infective endocarditis (especially in prosthetic heart valves), the causative organism may be one of the microorganisms commonly referred to as "skin contaminants."

Therefore, preparation of the venipuncture site prior to the collection of a specimen for blood culture analysis **must be meticulously performed** to reduce the contamination of blood culture specimens with microbial flora of the skin.

To accomplish this the phlebotomist should:

1. Use appropriate cleansing agents.
2. Apply the cleansing agents in the appropriate order.
3. **NEVER** repalpate the site after it was cleansed by aseptic technique.

Failure to recover organisms present in a blood culture is a "**false negative**". The causative organisms may be present in very small numbers and may not be detected if the proper volume is not collected. The **volume** of specimen collected is **critical** to the validity of test results. Too little blood may result in a false negative test result. Another cause of a false negative is contamination of the blood specimen with iodine. Iodine contamination is usually the result of excess iodine on the stopper prior to inoculation or not allowing the iodine on the patient's arm to dry. If an excessive amount of blood is collected it may clot in the collection

tube, rendering recovery of microorganisms difficult if not impossible. Injection of air into the anaerobe bottle can cause death of some anaerobic microorganisms and result in a false negative. For this reason, the anaerobe bottle must be inoculated first.

In summary, the proper collection of quality blood culture specimens is of critical importance. False positive and false negative results are directly related to the technique used by the phlebotomist. Septicemia may cause the death of the patient and must be diagnosed as quickly as possible so appropriate therapy can be initiated.

## EXERCISE 7: BLOOD CULTURE SPECIMEN COLLECTION

### Procedure

### Materials

1. Gloves
2. Iodine Swabs
3. Alcohol Swabs
4. Syringe
5. Needle for the syringe
6. Blood collection tubes/bottles

### Instructions:

1. Follow routine procedure for hand washing, gloving, equipment preparation and organization (be sure to pull back on the plunger of the syringe to loosen), patient approach, patient identification and selection of venipuncture site.
2. Explain to the patient that their physician has ordered a series of tests requiring a series of venipunctures. Explain that the venipuncture procedure will be performed several times over a particular time span. **Ask the patient about allergies to iodine.**
3. Apply the tourniquet, select the site, loosen the tourniquet.
4. Remove the alcohol/acetone pad (some kits come with a scrub which requires you to squeeze the handle to break the ampule contained within the prep kit, you must then continue to squeeze the broken ampule until the sponge becomes saturated) and cleanse the site with the alcohol pad for 60 seconds changing pads as necessary.
5. Remove the iodine swab, apply to puncture site, move the iodine in concentric circles **outward**.
6. Use the iodine swab to paint the top of the collection container.
7. Allow the site and the top of the collection container to air dry.
8. Reapply the tourniquet. Be careful that the ends of the tourniquet do not fall onto the puncture site, thereby contaminating it, if the tourniquet does accidentally touch the prepared puncture site, the site must be recleaned.
9. Perform the venipuncture, following routine venipuncture procedures. **Do not repalpate!**
10. If the blood culture is one of a series of samples to be drawn from a patient, the blood culture must be collected **first**.
11. Withdraw needle from vein and insert into the top of the blood culture container. **DO NOT HOLD THE CONTAINER IN YOUR HAND, THIS MAY RESULT IN A NEEDLE EXPOSURE.** Place the tube or container in a readily accessible area. The BEST method is to utilize a safety transfer device specifically designed to transfer blood from a syringe to the vacuum tubes.
12. Provide appropriate post-phlebotomy care to the patient.
13. Label the blood specimen collected, following standard labeling procedures. Be sure to include the site used and the number of the specimen in the series ordered.
14. Discard waste materials following standard procedures. **REMEMBER: gloves, biowipes, paper wrappings, needle caps and other non-biohazardous materials DO NOT GO IN THE ORANGE BAGS!!!**
15. Record the draw on your venipuncture log sheet.

## EXERCISE 7: Blood Culture Specimen Collection

Phlebotomist \_\_\_\_\_

Date \_\_\_\_\_

Patient \_\_\_\_\_

- A Performed**
- B Needs Improvement**
- C Not Performed**

- \_\_\_ 1. Washes hands, dons gloves at appropriate time.
- \_\_\_ 2. Role play: Approaches patient.
- \_\_\_ 3. Role play: Identifies patient
- \_\_\_ 4. Role play: Explains procedure to the patient
- \_\_\_ 5. Selects, prepares, and organizes equipment.
- \_\_\_ 6. Applies tourniquet.
- \_\_\_ 7. Selects site for venipuncture.
- \_\_\_ 8. Loosens tourniquet.
- \_\_\_ 9. Appropriately cleanses site with alcohol scrub.
- \_\_\_ 10. Appropriately cleanses site with iodine swab.
- \_\_\_ 11. Appropriately cleanses top of collection container with iodine.
- \_\_\_ 12. Allows site to air dry.
- \_\_\_ 13. Allows top of container to air dry.
- \_\_\_ 14. Reapplies the tourniquet without contaminating the venipuncture site.
- \_\_\_ 15. Position the syringe between the thumb and index finger.
- \_\_\_ 16. Uncaps the needle and inspects for manufacturer's defects.
- \_\_\_ 17. Anchors the vein selected.
- \_\_\_ 18. Inserts needle, bevel up, at correct angle.
- \_\_\_ 19. Inserts needle in the same direction as the vein.
- \_\_\_ 20. Pull back on the plunger with firm, gentle pressure until 3 mLs of blood has been collected.  
**NOTE:** The best technique is to pull the blood into the syringe as quickly as the vein can give it. If excessive force is used to pull blood into the syringe it will cause hemolysis of the blood specimen. For smaller veins use the "pull and wait" technique.
- \_\_\_ 21. After blood collection inserts needle into blood culture tube/container using proper technique.
- \_\_\_ 22. IMMEDIATELY ACTIVATE NEEDLE SAFETY DEVICE.
- \_\_\_ 23. Disposes of all used materials **in appropriate** waste containers.
- \_\_\_ 24. Label the filled tubes with the patient's name, number, date and time of collection, and your initials. The blood culture samples have the same information PLUS the number in the series and the site of collection.

## **EXERCISE 7: BLOOD CULTURE SPECIMEN COLLECTION STUDY QUESTIONS**

Name \_\_\_\_\_

Date \_\_\_\_\_

Points: 24

1. Define "septicemia" (0.5 point).
2. Define "bacteremia" (0.5 point).
3. What does "FUO" stand for (0.5 point)?
4. What is a blood culture specifically used for (1 point)?
5. Describe the manner in which you would verbally prepare a patient prior to collection of the blood culture sample (1 point).
6. Define "aerobic" (0.5 point).
7. Define "anaerobic" (0.5 point).



8. Define the term "second site" as it pertains to blood culture collection (1 point).
  
9. What is the minimum number of blood cultures which must be collected to obtain greater than 99 percent recovery of pathogenic organisms (0.5 point).
  
10. Describe the protocol utilized for collecting blood cultures **when systemic and localized infections** are suspected for each of the following (3 points):
  - a. Acute sepsis, meningitis, osteomyelitis, arthritis or bacterial pneumonia
  
  - b. Fever of unknown origin.
  
  - c. Early typhoid fever or brucellosis
  
11. Describe the protocol utilized for collecting blood culture specimens **when infective endocarditis** is suspected (2 points).

12. What is the **most critical** step involved in obtaining the blood culture specimen. (0.5 point).
  
13. Describe in detail the proper manner for preparing the site for collection of a blood culture (2 points).
  
  
  
  
  
  
  
  
  
  
14. What question should be asked of the patient prior to drawing a blood culture? Why? (1 point)
  
  
  
  
  
  
  
  
  
  
15. State the composition of ChloroPrep AND the advantage it has over traditional site preparation methods. (1 point)
  
  
  
  
  
  
  
  
  
  
16. Describe in detail the Isostat System for collection of blood cultures (1.5 points).
  
  
  
  
  
  
  
  
  
  
17. What does the blood culture bottle/container have in it and what purpose does it serve? (1 point).

18. What does ARD stand for **AND** for what purpose is it used for in the collection of blood cultures (1 point).
  
19. Describe the special labeling requirements for blood culture specimens (1.5 points).
  
20. Define "false positive" as it relates to blood culture specimens **AND** state the most common cause (1 .5 point).
  
21. Define "false negative" as it relates to blood culture specimens **AND** state one cause (1.5 point).
  
22. Contamination of blood cultures should not exceed what percent of the total collected (0.5 point).