

EXERCISE 7: BLOOD CULTURE SPECIMEN COLLECTION

Skills: 40 points

Objectives:

1. Differentiate between sterile and antiseptic techniques.
2. Define the following terms: FUO, septicemia, bacteremia, aerobic and anaerobic.
3. Describe the type of patient who may be a candidate for a blood culture.
4. State specifically what blood cultures are used for.
5. Discuss the interview process used for patient preparation when drawing blood culture samples especially iodine allergies..
6. State the number of blood culture collections necessary for sufficient recovery of clinically significant microorganisms.
7. Describe the different protocols used for the collection of blood cultures for systemic and localized infections and infective endocarditis.
8. Define the term "second site" as it pertains to blood culture collection.
9. State what the blood culture bottle or container has in it and the purpose it serves.
10. List the materials and supplies necessary for collection of a blood culture specimen.
11. State the reason that site preparation is so important in the collection of blood cultures.
12. Compare and contrast the proper procedure for preparing a blood culture site using the iodine versus the chlorhexidine gluconate.
13. State the advantage chlorhexidine gluconate products have over the traditional site preparation method.
14. State the maximum allowable blood culture contamination rate.
15. Define Afalse positive@ and Afalse negative@ as the terms relate to blood cultures.
16. State two causes of false positive and false negative blood culture results.
17. Discuss when the antibiotic removal device (ARD) bottles are used and how they work.
18. Describe the ISOSTAT blood culture collection system and the purpose for it=s use.
19. State how blood culture samples must be labeled.
20. 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.

Syringe/Straight Needle

When using a syringe/straight needle:

1. ***It is important to Abreathe@ the syringe prior to use.*** This is accomplished by moving the plunger back and forth in the barrel before using. This breaks the seal on the syringe. Failure to breathe the syringe may result in the needle being pulled from the vein when the seal breaks unexpectedly. The phlebotomist will be pulling hard on the plunger and when the seal is suddenly released too much force is being applied in a backward motion may result in the needle being pulled from the vein.
2. Once the needle is inserted into the vein the plunger should be pulled back gently, yet firmly. *Pulling back on the plunger with excessive force to speed blood coming into the syringe may cause the vein to collapse or, if extreme pressure is applied, may cause hemolysis of the blood sample.*

Patient Preparation

Explain to the patient, if they are coherent, that the physician has ordered a series of tests and you will have to draw their blood several times at timed intervals. Any additional questions about the procedure need to be referred 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. Routine venipunctures require an antiseptic to be used on the site. Blood culture collections require a sterile site, one that is free of living microorganism. Due to the special site preparation once the site has been prepared **DO NOT REPALPATE!** Repalpating the site will contaminate it.

The **traditional** method involves first cleansing the site for 60 seconds 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 which is allowed to dry to kill surface skin bacteria. If this procedure is used the patient must be asked about allergies to iodine. If the patient does have an iodine allergy, the only recourse is to cleanse thoroughly with 70 percent alcohol a second time, the use of green soap or another method. The iodine is painted on the area, with a circular motion, starting at the site of the puncture and moving in concentric circles outward. Do not flood 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.

The newest method to prepare the site uses a less toxic product called **chlorhexidine gluconate**. ChlorPrep swabs and Chlorascrub swabs utilize this chemical Both are one-step applications of the chlorhexidine gluconate and 70% isopropyl alcohol. The Chloroprep swab 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 and allowed to dry for one minute. The Chlorascrub swab requires a **15 second** prep time. Both methods are quicker and lead 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 needle is inserted. Once the flip off cap is removed, the septum is cleaned with an alcohol pad. Allow the alcohol to dry for 60 seconds. The proper amount of blood is drawn with a syringe. The bottles are inoculated with blood using a safety transfer device. Always fill 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 tubes of blood are

collected are needed ***blood cultures are always 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 manufacturer's 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.

Antibiotic Removal Device (ARD) - A blood culture bottle with a resin solution which inactivates antimicrobial agents. This bottle is collected, in addition to the aerobic and anaerobic bottles, if a patient is on antimicrobial therapy. Antibiotics present in the blood may inhibit bacterial growth.

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

Quality control in blood culture collection involves following procedures exactly to prevent false positive or false negative results in the blood culture.

False Positive

This is a blood culture which grows organisms but the organisms were NOT present in the patient's blood. This is caused by collecting the blood culture from an improperly prepared site, which results in the blood culture bottles being contaminated with microbial flora (organisms) from the skin. This is also known as a "contaminated" blood culture.

Contamination of blood culture specimens should be limited to less than 3% (i.e., 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 to be in compliance with the procedure.

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.

False Negative

The blood culture may not grow organisms (be negative) yet the patient is suffering from sepsis. There are many causes of false negatives such as:

1. The causative organisms being present in very small numbers which may not be detected if the proper volume of blood is not collected. The **volume** of specimen collected is **critical** to the validity of test results.
2. Contamination of the blood specimen with cleansing agent. 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.
3. If an excessive amount of blood is collected it may clot in the collection tube, rendering recovery of microorganisms difficult if not impossible.
4. 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.

False negatives are considered when the blood cultures are negative yet the patient still exhibits signs of sepsis.

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.

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Procedure

Materials

1. Gloves
2. Iodine Swabs, Chloroprep or Chlorascrub 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 if traditional method is used.**
3. Apply the tourniquet, select the site, loosen the tourniquet.
4. Clean the site:
 - a. **Traditional** - scrub site with alcohol for 1 minute, paint site with iodine and allow to dry completely.
 - b. **Chloroprep** - scrub site for 30 seconds, allow to dry for 1 minute.
 - c. **Chlorascrub Swab** – scrub site for 15 seconds allow to dry for 30 seconds.
5. Swab tops of bottles/tubes with alcohol and allow to dry for 1 minute.
6. 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 re-cleaned.
7. Perform the venipuncture following routine venipuncture procedures. **Do not repalpate!**
8. If the blood culture is one of a series of samples to be drawn from a patient, the blood culture must be collected **first**.
9. Draw the correct amount of blood into the syringe using proper technique.
10. Release tourniquet.
11. Withdraw needle from vein and activate needle safety device.
12. Apply pressure to venipuncture site with biowipe.
13. Remove needle from syringe and attach safety transfer device.
14. Allow half of the blood to be released into each bottle or tube.
15. Provide appropriate post-phlebotomy care to the patient.
16. Label the blood specimen using standard labeling procedures, the site used and the number of the specimen in the series ordered.
17. Discard waste materials following standard procedures. **REMEMBER: gloves, biowipes, paper wrappings, needle caps and other non-biohazardous materials DO NOT GO IN THE BIOHAZARD CONTAINER!!!**
18. Have your partner complete the Venipuncture Practice Skills Assessment Form.
19. Record the draw on your venipuncture log sheet.

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STUDY QUESTIONS**

Name _____

Date _____

Points: 27

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

16. State the chemicals present in the ChloraPrep and Chlorascrub products. (1 point)
17. State the advantage ChloraPrep and Chlorascrub have over traditional site preparation methods. (1 point)
18. Describe in detail the Isostat System for collection of blood cultures (1.5 points).
19. What does the blood culture bottle or container have in it and what purpose does it serve? (1 point).
20. What does ARD stand for **AND** for what purpose is it used for in the collection of blood cultures (1 point).
21. Describe the special labeling requirements for blood culture specimens (1.5 points).
22. 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).