GALAXY INTERNATIONAL INTERDISCIPLINARY RESEARCH JOURNAL (GIIRJ)
ISSN (E): 2347-6915
Vol. 10, Issue 6, June (2022)

BLOOD CULTURE FOR SEPSIS DETECTION

Ms Sriparna Acharyya,
Mahamana Pandit Madan Mohan Malviya Cancer Centre Varanasi Uttar Pradesh 221005,
(A Unit of Tata Memorial Centre Mumbai, Department of Atomic Energy)

Dr Meena K. Krishnan,
Mahamana Pandit Madan Mohan Malviya Cancer Centre Varanasi Uttar Pradesh 221005,
(A Unit of Tata Memorial Centre Mumbai, Department of Atomic Energy)

Mr Avadhesh Kumar Yadav,
Mahamana Pandit Madan Mohan Malviya Cancer Centre Varanasi Uttar Pradesh 221005,
(A Unit of Tata Memorial Centre Mumbai, Department of Atomic Energy)

Ms Subarna Chakraborty,
Mahamana Pandit Madan Mohan Malviya Cancer Centre Varanasi Uttar Pradesh 221005,
(A Unit of Tata Memorial Centre Mumbai, Department of Atomic Energy)

Ms Jaya Chatterjee,
Mahamana Pandit Madan Mohan Malviya Cancer Centre Varanasi Uttar Pradesh 221005,
(A Unit of Tata Memorial Centre Mumbai, Department of Atomic Energy)

Mr Vineeth P,
Mahamana Pandit Madan Mohan Malviya Cancer Centre Varanasi Uttar Pradesh 221005, (A unit of Tata Memorial Centre Mumbai, Department of Atomic Energy)

Mr Rajendra Sahu
Mahamana Pandit Madan Mohan Malviya Cancer Centre Varanasi Uttar Pradesh 221005,
(A Unit of Tata Memorial Centre Mumbai, Department of Atomic Energy)

ABSTRACT

Collection and inoculation of blood into the culture medium to grow pathogenic microorganisms for diagnosis of sepsis. Blood culture is carried out mainly in case of bacteremia, fungemia, or septicemia. Blood culture collection is a sensitive procedure which requires more attentiveness. Nurses work as the first contact person who performs all diagnostic and therapeutic functions. For better diagnosis and error-free results. The nurse should be aware of the blood culture collection procedure, which includes the process from raising a request to receiving a sample at the laboratory receiving counter,

Keywords: blood culture, sepsis marker, culture bottle, aerobic, anaerobic.

BACKGROUND INFORMATION

It is a Collection and inoculation of blood into the culture medium to grow pathogenic microorganisms for diagnosis of sepsis. Blood culture is carried out mainly in case of bacteremia, fungemia, or septicemia.

Bacteremia – The presence of viable bacteria in the bloodstream.

Septicemia is when microorganisms (mainly bacteria) circulate and multiply from toxic products in the patient blood.

Organisms commonly isolated from the blood culture:

1. S.aureus
2. E Coli
3. CONS
4. Enterococcus spp
5. C Albicans
6. P Aureginosa
7. K Pneumoniae
8. Viridands Strepto Coccia
9. S Pneumoniae
10. Entero Bacter Cloacae
11. Proteus spp

BLOOD CULTURE

It is an essential investigation for diagnosing bloodstream infections (sepsis). This investigation is performed when the patient shows symptoms of septicaemia.

"Sepsis is a life-threatening condition that affects organ dysfunction caused by a dysregulated host response to infection."

OBJECTIVE OF REVIEW

To update knowledge about

1. Introduce the blood culture
2. Importance of blood cultures
3. Time of blood culture collection
4. The volume required for blood Culture
5. How many bloods should culture sets be collected?
6. Media used for Blood Culture
7. Timing of blood cultures
8. Method applied in the collection of blood cultures
9. Recommended Duration of incubation
10. Contaminant or a true pathogen

Blood - Culture

A blood culture collection procedure is a laboratory test in which blood is taken from the patient and inoculated into bottles containing culture media to determine whether infection-causing microorganisms (bacteria or fungi) are present in the patient's bloodstream.

Blood cultures are intended to :

- Confirm the presence of microorganisms in the bloodstream.
- Identify the microbial aetiology of the bloodstream infection
- Help determine the source of infection
- Provide an organism for susceptibility testing and optimization of antimicrobial therapy.

Importance of blood cultures

- Most widely used diagnostic tool for the detection of bacteremia and fungemia.
- Diagnosing the aetiology of bloodstream infections and sepsis has significant implications for the treatment of those patients.
- Positive blood culture establishes or confirms an infectious aetiology for the patient's illness.
- Positive blood cultures also provide the etiologic agent for antimicrobial susceptibility testing, enabling optimization of antibiotic therapy.

Providing adequate antibiotic therapy within the first 24-48 hours leads to :

- Decreased infection-related mortality
- Earlier recovery and shorter length of hospital stay.
- Less risk of adverse effects
- Reduced risk of antimicrobial resistance.
- Cost reduction (length of hospitalization, therapy, diagnostic testing).

When should a blood culture be performed

Clinical manifestations in a patient which may lead to a suspicion of a bloodstream infection are :

- Undetermined fever or hypothermia
- Shock, chills, rigour
- Severe local infections (such as meningitis, endocarditis, pneumonia, pyelonephritis, intra-abdominal suppuration)
- Abnormally raised heart rate
- Low or increased blood pressure
- Raised respiratory rate

Collection of Blood cultures

As soon as possible, post-onset of clinical symptoms. Ideally, pre-administration of antimicrobial treatment.

If the patient is already on antimicrobial treatment, recovery of microorganisms may be elevated by collecting the blood sample immediately before administering the next dose.

What volume of blood should be collected?

The blood volume obtained for each blood culture set is the most significant variable in recovering microorganisms from patients with bloodstream infections.

Adults: The recommended blood volume per culture is 20 to 30ml.
Since each set includes an aerobic and an anaerobic bottle, each bottle should be inoculated with approximately 10ml of blood.
Two or three bottle sets (two bottles per set) are recommended per septic episode, i.e. 40 to 60 ml blood collected from the patient, with 10ml per bottle.

Pediatric:- The recommended volume of blood to collect should be based on the patient's weight. An aerobic blood collection bottle should be used unless an anaerobic infection is suspected (1).
They are also recommended for a sample of 1-1.5ml for children weighing less than 11kg and 7.5ml for a patient weight 11-17kg to be drawn into one culture bottle.

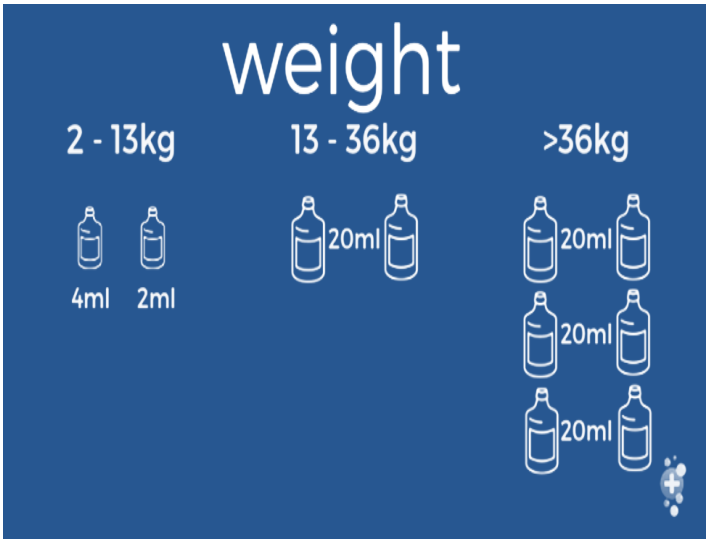

Figure 1 volume of blood culture

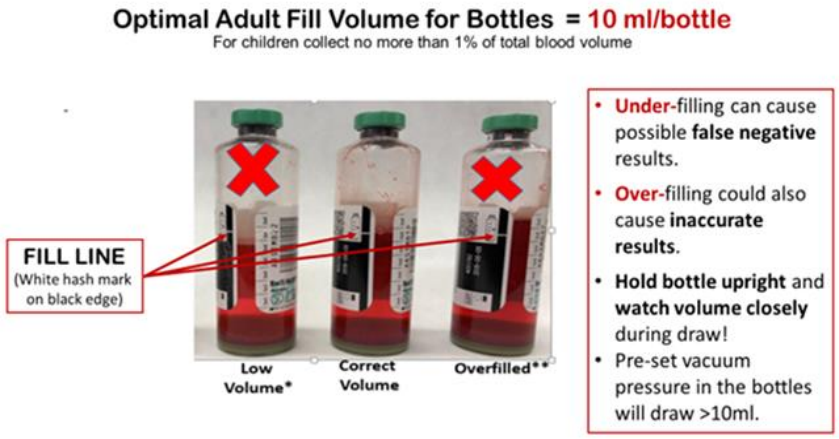

Figure 2 volume of blood Culture
Image Source- https://lug.hfhs.org/bloodCult.htm

How many blood should culture sets be collected?

A single blood culture bottle or set of culture bottles should never be drawn out from adult patients. This practice will cause an inadequate volume of blood cultured, and many bacteremias may be missed.

Since bacteria and fungi may not constantly be present in the bloodstream, the sensitivity of a single blood culture set is limited.

Guidelines recommend collecting 2 or 3 blood culture sets for each septic episode.

Using continuous blood culture monitoring systems, it was seen that a cumulative yield of pathogens from 3 blood culture bottles (2 bottles per set), with a blood volume of 10 ml per bottle, was 73.1% with the first set, 89.7% with the first two sets and 98.3% with the first three sets (2).

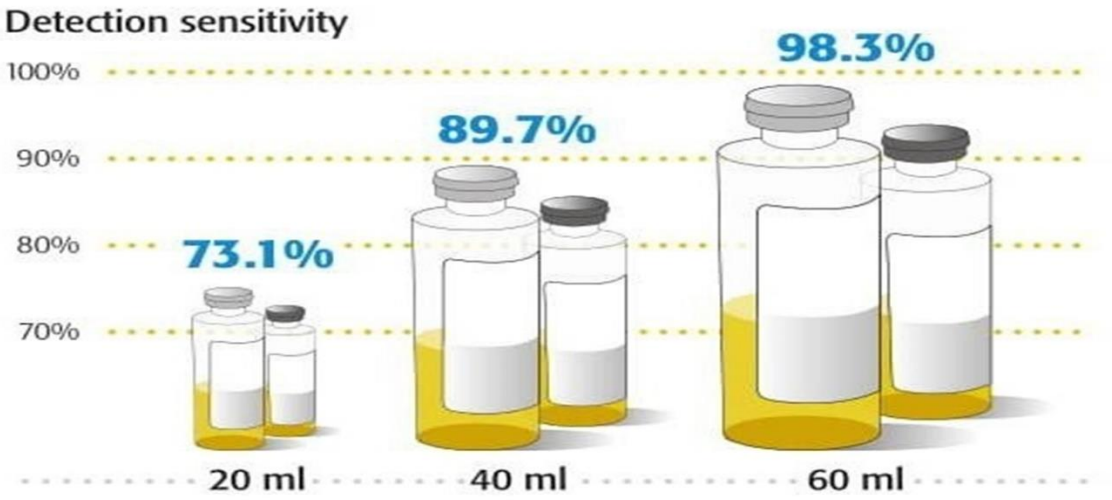

Figure 3 Detection sensitivity

Image source -https://microbeonline.com/blood-culture-indications-timing-and-volume/

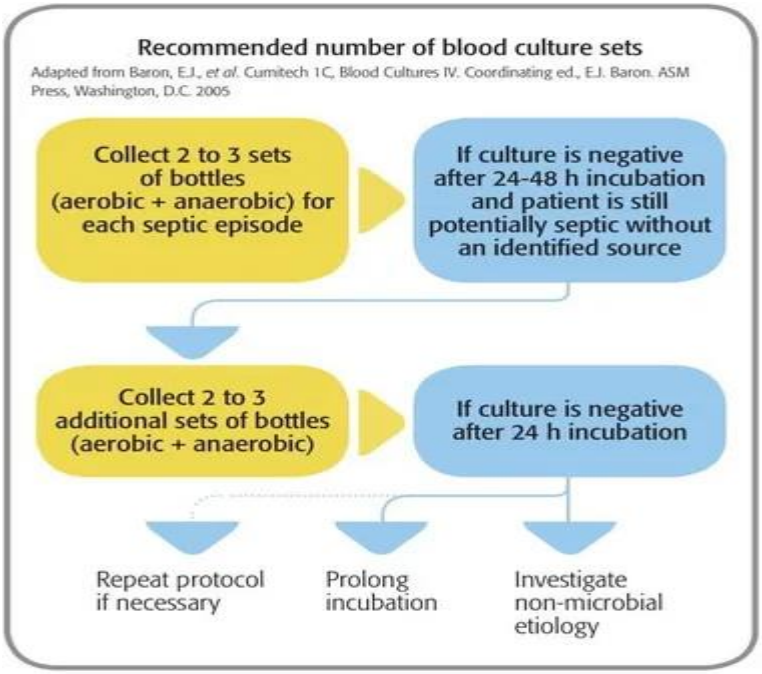

Figure 4 Recommended number of Blood culture Set

Image Source - https://microbeonline.com/blood-culture-indications-timing-and-volume/

Which media to use?

Blood culture bottles contain a growth medium, which encourages microorganisms to multiply, and an anticoagulant that prevents clotting.

The most common growth media are nutrient broths (liquid nutrient media).

Its recommended that each adult routine blood culture set include paired aerobic and anaerobic blood culture bottles.

The blood drawn must be divided uniformly between aerobic & anaerobic culture bottles.

If an anaerobic bottle is not used, it should always be replaced by an additional aerobic bottle to ensure a sufficient blood volume is cultured.

Which bottle should be inoculated first?

If using a winged blood collection set, then the aerobic bottle should be filled first to prevent the transfer of air in the device into the anaerobic bottle.

If using a needle syringe, inoculate the anaerobic bottle first to avoid air entry.

If the amount of blood collected is less than the recommended volume, approximately 10 ml of blood volume should be inoculated into the aerobic bottle first.

Timing of blood culture:

- Before starting antimicrobial therapy.
- At the time of fever.
- Minimum 30-60-minute interval between 2 samples except in critically ill septic patients.
- In continuous bacteremia- the timing of blood culture is not important, but in intermittent bacteremia, 2 or 3 cultures should be spaced an hour apart.

8. How to collect blood cultures

A properly collected sample free from contamination is key to accurate and reliable blood culture results.

Key steps to good sample collection:

1. Before use, examine the bottles for evidence of damage, deterioration, or contamination.
2. The expiry date printed on each bottle should be checked.
3. Strictly follow the collection protocol in use in the healthcare setting, including standard precautions.
4. The labelling of Blood culture bottles should be done clearly and correctly, including patient identification, date and collection time, and puncture site (venepuncture or intravascular device).
5. Each blood culture should include an aerobic and an anaerobic bottle.
6. Blood for culture should be preferably drawn from veins, not arteries.
7. It is recommended to avoid collecting blood from a venous or arterial catheter since these devices are often associated with higher contamination rates.
8. Carefully disinfect the skin before collection of a sample using an appropriate disinfectant (chlorhexidine in 70% isopropyl alcohol or tincture).
9. Transport the inoculated bottles as quickly as possible.

10. All blood cultures sample should be documented in the patient's notes, including date, time, collection site, and indications.

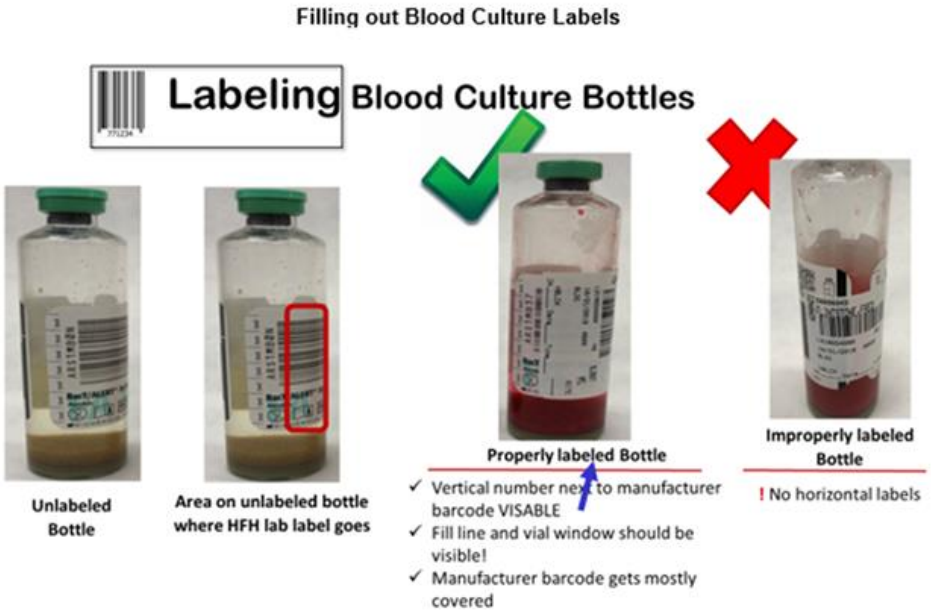

Figure 5 Labelling of Blood culture
Image source - https://lug.hfhs.org/bloodCult.htm

How many days of incubation are recommended?

As per CDC Guidelines recommended standard incubation period for routine blood cultures is five days. However, in the presence of heavy bacteremia, 3 days may be adequate to recover over 97% of clinically significant microorganisms.

Is it a contaminant or a true pathogen?

Contamination of blood cultures during the collection process can produce a significant level of false-positive results.Contamination can come from several sources: such as the patient's skin, the equipment utilized to take the sample, the hands of the health workers Collecting the blood sample, or the environment.

Contamination rates may be most effectively minimized by strict following hand hygiene techniques and best techniques for blood collection, especially during the stages of skin antisepsis, venepuncture, and sample transfer to blood culture bottles.

Impact of contamination rates:

A false-positive result can lead to: -

✓ Increased length of hospital stays
✓ Increase in intravenous antibiotic charges.
✓ Additional charges.
✓ Increase in laboratory charges
✓ 3 days longer on antibiotics.

Blood culture collection: -

1. **Prepare blood collection kit-** Confirm the patient's identity and gather all required articles.Check the expiry date.
2. **Prepare bottles for inoculation** -Hand wash, Remove the plastic flip cap and disinfect the septum using an appropriate disinfectant. (fresh swab for each bottle). Allow drying.
3. **Prepare venipuncture site-**Apply tourniquet and palpate vein. Apply sterile gloves. Cleanse the skin using an appropriate disinfectant.
4. **Venipuncture** -Attach winged blood collection set to the adapter. To prevent contamination, do not re-palpate the prepared vein before inserting a needle.
5. **Culture bottle inoculation-**Place the adapter cap over the aerobic bottle and press straight down to pierce the septum. Hold the bottle upright, below the level of the site, and add 10ml blood per adult bottle and up to 4ml per pediatric bottle. Fill in the target market.

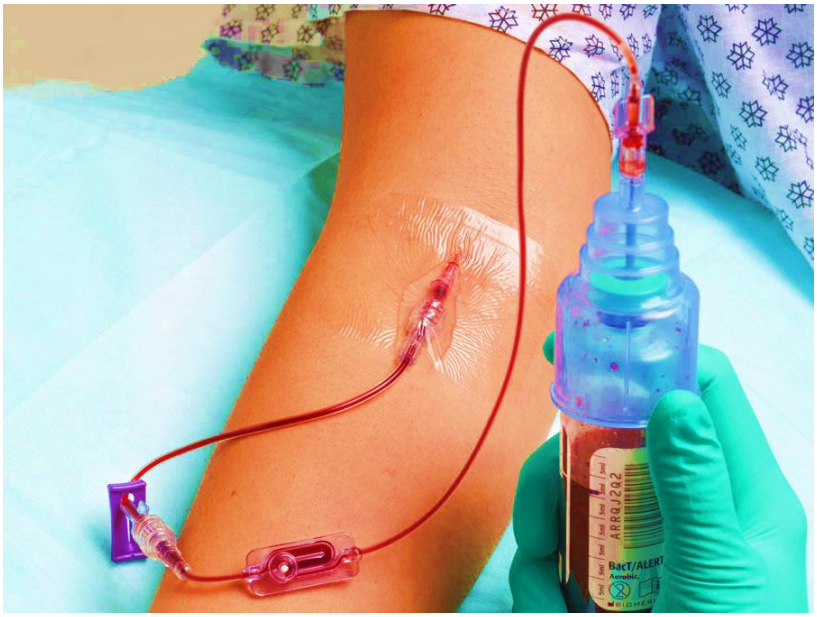

Figure 6 Blood culture Collection

Image Source - https://www.kurin.com/freshly-placed-peripheral-catheter-collections/m-piv18-vac-draw_156/

6. **Other blood tests-**If other blood tests are required. Always collect culture first.

7. **Finish the procedure-** Discard all the articles. Record the procedure. Proper labelling. Proper transport of the bottles to the lab.

CONCLUSION

Blood culture collection is a sensitive procedure which requires more attentiveness. Nurses work as the first contact person who performs all diagnostic and therapeutic functions. For better diagnosis and error-free results. The nurse should be aware of the blood culture collection procedure, which includes the process from raising a request to receiving a sample at the laboratory receiving counter.

REFERENCES

1 Tankeshwar A. Microbe Online. [Online].; 2022 [cited 2022 June 15. Available from: https://microbeonline.com/blood-culture-indications-timing-and-volume/.

2 BioMérieux S.A. Blood Culture. [Online]. [cited 2022 June 15. Available from: https://www.biomerieux-diagnostics.com/sites/clinic/files/blood_culture_booklet.pdf.