Microbiology - Blood Culture Practical

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Objectives

- Definition, causes, types and course of bacteremia
- Clinical picture of bacteremia
- Blood culture: indications, contamination, venipuncture, volume, number, and timing
- Steps, laboratory processing and interpretation of blood culture
- Cases studies of bacteremia

Septicemia/Bactremia

- Bacteremia: presence of viable bacteria circulating in blood. The blood is usually a sterile substance
- Types of bacteremia:

1. Extravascular via the lymphatic's
2. Intravascular via CVS infections

- Course of bacteremia:

1. Transient: Disruption of mucosal surfaces (dental or surgical procedures)
2. Intermittent: Associated with abscesses
3. Continuous: Infective endocarditis

- Intravenous catheter is a common causes of bacteremia in hospitals

Causes of Bacteremia

- *S. aureus*
- *S. pyogenes*
- *S. pneumoniae*
- *H. influenzae*
- *Enterobacteriaceae*
- *Bacteroides*
- *Pseudomonas aeruginosa*
- *Candida species*

Bacteremia: Contaminants

- Contamination: Growth of organisms in the blood culture bottle that were not present in the patient's blood stream

1. Coagulase (-) Staphylococci
2. Corynebacterium species
3. Bacillus species
4. Viridans Streptococci

Occurrence of False Positive Blood Cultures (Trash)

	True (%)	Trash (%)
S. aureus	87	6
Coag negative staph	12	82
Enterococcus	70	16
Diphtheroids	2	96
C. perfringens	23	77

Clinical Picture of Septicemia

- Looks very ill-septic
- Hyperthermia/hypothermia
- Tackycardia
- Tackypnoea
- Septic shock-hypotension
- Multiorgan failure
- Fever of unknown origin
- Risk factors-intravenous catheter
- Clinical manifestation of source of infection: pneumonia, abscess, UTI, GE

Indications for Blood Cultures

- Presence of 2 or more of:

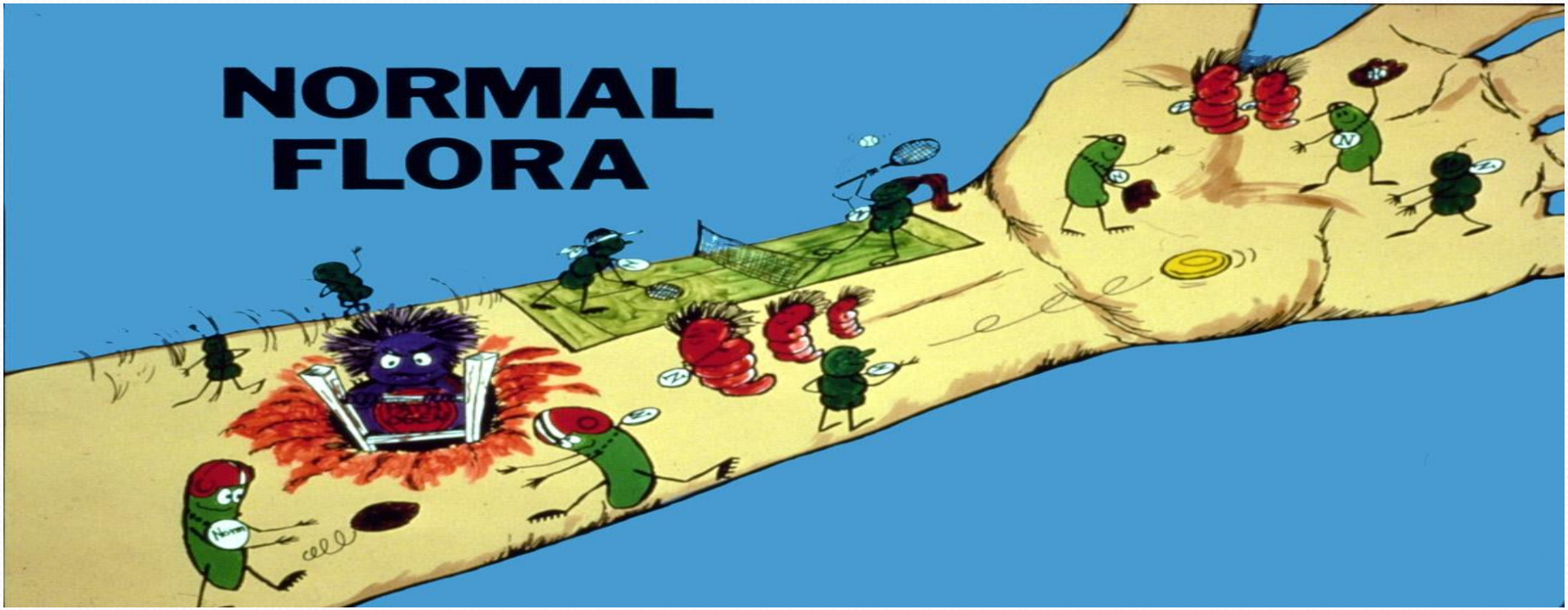
1. Core Temperature <36 or>38
2. Respiratory Rate >20 per min
3. WBC >12 or <4 x109
4. Pulse >90bpm
5. Altered mental state

Blood Culture

- A microbiological culture of the blood to detect infection with a micro organism, specifically bacteria or candida
- The primary means for establishing a diagnosis of sepsis is by blood culture
- A sample of the patient's blood is obtained and cultured, growth is detected, and the organisms are isolated, identified, and tested for antimicrobial susceptibility

1. Venipuncture

- The skin over the vein must be carefully disinfected to reduce the probability of contamination
- Although it is not possible to “sterilize” the skin, quantitative counts can be markedly reduced with a combination of **70% alcohol and an iodine-based antiseptic**
- Blood is drawn directly into a blood culture bottle or a sterile blood collection vacuum tube containing an anticoagulant free of antimicrobial properties
- Sodium polyanethol sulfonate is currently preferred; citrate and EDTA have antibacterial activity
- Blood should not be drawn through indwelling venous or arterial catheters unless it cannot be obtained by venipuncture


NORMAL
FLORA

2. Volume

- The number of organisms present in blood is often low (1 organism/mL)
- Small samples yield fewer positive cultures than larger ones. For example, as the volume sampled increases from 2 to 20 mL, the diagnosis increases by 30 to 50%
- Samples of at least 10 mL should be collected from adult patients

3. Number

- If the volume is adequate, it is rarely necessary to collect more than two or three blood cultures to achieve a positive result
- In intravascular infections (eg, infective endocarditis), a single blood culture is positive in more than 95% of cases
- Studies of sequential blood cultures from bacteremic patients without endocarditis have yielded 80 to 90% positive results on the first culture, more than 90 to 95% with two cultures, and 99% in at least one of a series of three cultures

4. Timing

- The best timing schedule for a series of two or three blood cultures is dependent on the bacteremic pattern of the underlying infection and the clinical urgency of initiating antimicrobial therapy

1. Transient bacteremia is usually not detected, because organisms are cleared before the appearance of any clinical findings suggesting sepsis
2. The continuous bacteremia of infective endocarditis is usually readily detected, and timing is not critical
3. Intermittent bacteremia presents the greatest challenge because fever spikes generally occur after, rather than during, the bacteremia. Bacteremia is more likely to be present and sustained in the early acute stages of infection

- Closely spaced samples are less likely to detect the organism than those spaced an hour or more apart
- In urgent situations, when antimicrobial therapy must be initiated, two or three samples should be collected at brief intervals and therapy begun as soon as possible
- It is generally not useful to collect blood cultures while the patient is receiving antimicrobics unless none were collected before therapy or there is a change in the clinical course suggesting superinfection

How to Take Blood Culture

- Equipment and materials:

1. Sharps bin
2. Gloves (non-sterile)
3. Needle and Syringe or Safety Blood Collection system
4. Alcohol/iodine disinfectant
5. Dressing as required
6. Blood Culture bottles
7. Blood culture sticker for notes

Steps

- Taking a blood culture is clinically indicated for this patient
- Decontaminate blood culture bottle tops
- Carry out hand hygiene before touching the patient
- Apply alcohol based skin antiseptic and leave to dry
- Don't touch critical parts
- Inoculate blood culture bottles first
- Document rationale, date and time of blood culture and operator

Laboratory Processing

- The basic blood culture procedure of incubating blood in an enriched broth is quite simple, but considerable effort must be expended to ensure detection of the broadest range of organisms in the least possible time
- Daily examination of cultures for 1 week or more and a routine schedule of stains and/ or subcultures of apparently negative cultures are required to detect organisms such as *H. influenzae* or *N. meningitidis*, which usually do not produce visual changes in the broth

- Automated blood culture systems detect metabolic activity (primarily CO_2 generation) in broth culture for initial detection in place of the conventional visual and staining examinations. These systems detect growth sooner than conventional methods but still require subculture for confirmation, identification, and susceptibility testing
- Because the blood is normally sterile, the interpretation of blood cultures growing a pathogenic organism is seldom a problem
- The major problem is the differentiation of agents causing transient bacteremia and skin contamination from those opportunists associated with an intravascular or extravascular infection

- Despite skin disinfection, 2 to 4% of venipunctures result in contamination of the culture with small numbers of cutaneous flora such as *S. epidermidis*, corynebacteria (diphtheroids), and propionibacteria
- The presence of these organisms in blood cultures can be considered a result of skin contamination unless

1. Quantitative procedures indicate large numbers (5 organisms/mL)
2. Timing of growth- very rapid growth within 24 hours
3. Repeated cultures are positive for the same organism
4. Multiple puncture sites are positive for the same organism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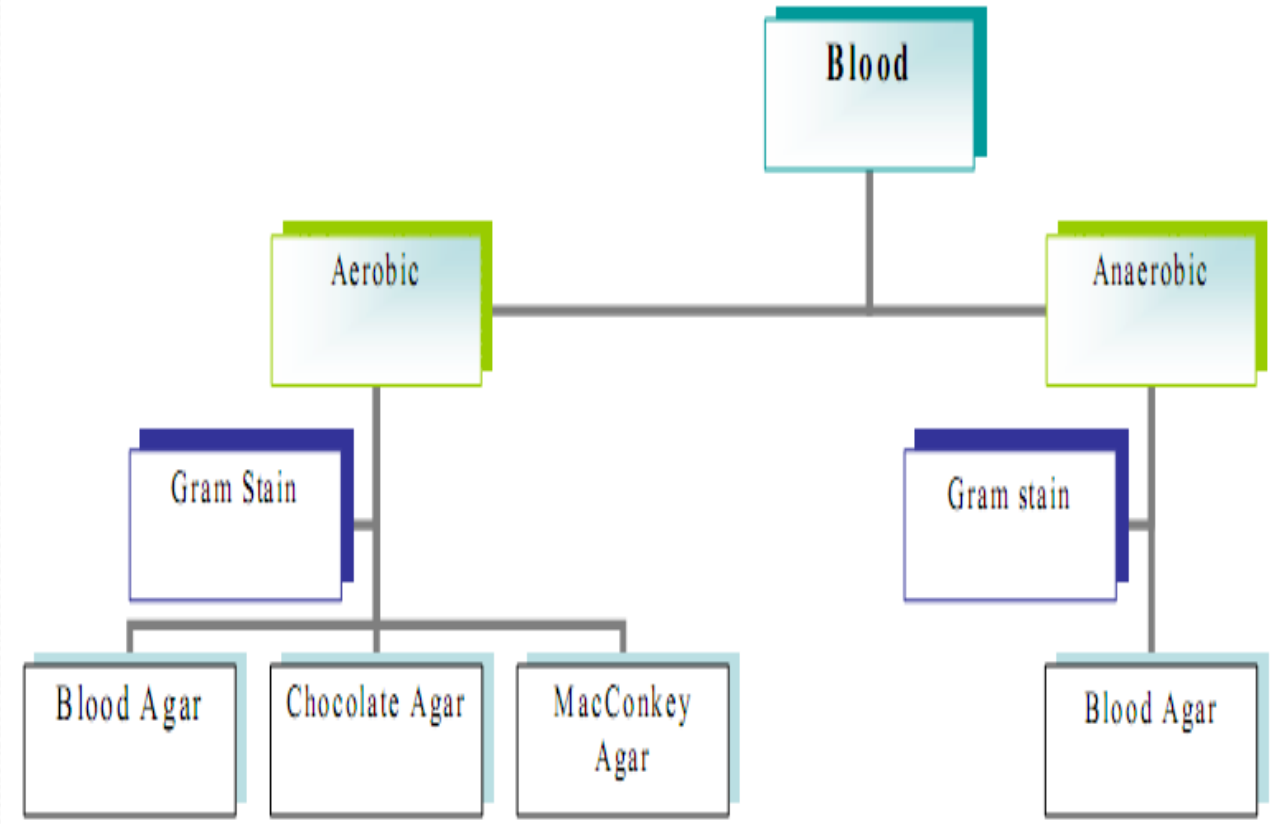
Blood
Aerobic
Anaerobic
Gram Stain
Gram stain
Blood Agar
Chocolate Agar
MacConkey Agar
Blood Agar