Bloodstream infections

Bloodstream infections (BSI)

- 200,000 to 300,000 cases of BSI (US)
- Mortality: 20% to 50%
- Bacteremia – presence of bacteria in blood stream
- Septicemia – bacteremia plus clinical signs and symptoms of bacterial invasion and toxin production

Common agents of BSI

- 1975 to 1977
  - *E. coli*
  - *S. aureus*
  - *S. pneumonia*
  - *K. pneumoniae*
  - *P. aeruginosa*
  - *B. fragilis*
  - *Enterococcus spp.*
  - *S. pyogenes*
  - *C. albicans*
  - *P. mirabilis*
- 1992 to 1993
  - *S. aureus*
  - *E. coli*
  - *CoNS*
  - *K. pneumoniae*
  - *Enterococcus spp.*
  - *P. aeruginosa*
  - *S. pneumoniae*
  - *Viridans group strep*
  - *C. albicans*
  - *E. cloacae*
- 1995 to 2002
  - *CoNS*
  - *S. aureus*
  - *Enterococcus spp.*
  - *Candida spp.*
  - *E. coli*
  - *Klebsiella spp.*
  - *P. aeruginosa*
  - *Enterobacter spp.*
  - *Serratia spp.*
  - *Acinetobacter spp.*

Adapted from Reimer, LG et al. Clin Micro Reviews 1997;10(3):444-465 and Wisplinghoff, H et al., CID 2004:39;309-317

Etiology of BSI

Etiology of BSI

- Viruses:
  - Epstein Barr virus – Lymphocyte
  - CMV – monocytes, PMN cells and lymphocytes
  - HIV and other human retroviruses – lymphocytes

Types of Bacteremia

Transient	Intermittent	Continuous
Manipulation of infected sites ex- abscesses, furuncles, and cellulitis	Undrained intra abdominal abscessese, perinephric abcess, Prostatic abscesses et – these are common causes of PUO	Cardinal feature of endo vascular infections most notably acute, sub acute IE
Instrumentation of mucosal surfaces colonized with regional flora(Dental, urologic procedures)		
Surgery involving prostate, hysotectomies, suction curattage, debridement of infected wounds and burns		First few weeks of Typhoid fever and Brucellosis

Predisposing Factors

- Immunosuppressive agents
- Widespread use of broad-spectrum antibiotics
- Invasive procedure
- Surgical procedure
- Debilitated ill patients

Types of BSI

- **Intravascular infections**
  - ✓ Infective endocarditis
  - ✓ Mycotic Aneurysm
  - ✓ Suppurative thrombophlebitis
- Intravenous catheter-associated bacteremia
- **Extravascular infections**

- Septicemia
- Septic shock
- DIC

Immunocompromised patients

Clinical manifestations

Diagnosis of BSI

- Factors affect the recovery of microorganisms from blood:
  - The type of bacteremia
  - The number and timing of blood culture
  - The method of specimen collection
  - The blood volume
  - The interpretation of the results
  - Patient population

Blood collection

A. Aseptic collection procedure is critical
   - Antisepsis
   - Precautions

B. Amount of blood
   - 1:10 ratio of blood to broth
     - Younger than 10 years –> 1 ml of blood for every year of life
     - Over 10 years –> 10 – 20 ml

C. Frequency of Collection
   - Depends if bacteremia is transient, intermediate or continuous
   - Adequate blood volume
   - Prior antibiotic therapy

D. Timing
   - Intravascular infections
   - Intermittent bacteremia

E. Miscellaneous matters
   - Anticoagulation
   - Dilution
   - Blood culture media

Blood collection

Conventional Broth Systems

- One aerobic bottle and one anaerobic bottle per blood collection
- Aerobic broth contains soybean casein digest broth, Tryptic or trypticase soy broth, Brucella agar or Columbia broth base
- Anaerobic broth is usually the same as aerobic with addition of 0.5% cysteine in an aerobic environment
- Must be subcultured and gram stained manually

Types of blood culture bottle

- Resin containing media
  - The BACTEC system
- Activated charcoal particles
  - BacT/ALERT + BHI

I. Conventional Blood Cultures

II. Self-Contained Subculture System

III. Lysis Centrifugation

IV. Instrument-based system

V. Techniques to detect IV Catheter-Associated Infections

Culture techniques

Culture techniques

I. **Conventional Blood Cultures**

- Low oxidation reduction potential
- Transient venting
- Constant agitation

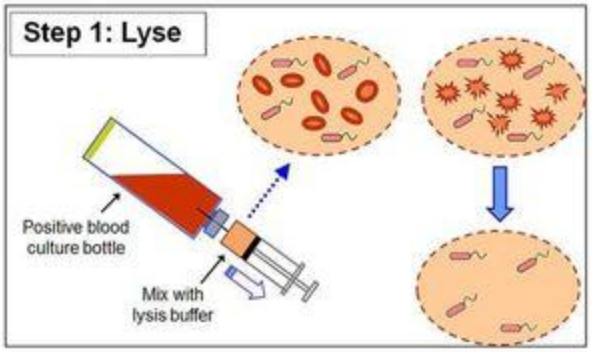
Culture techniques

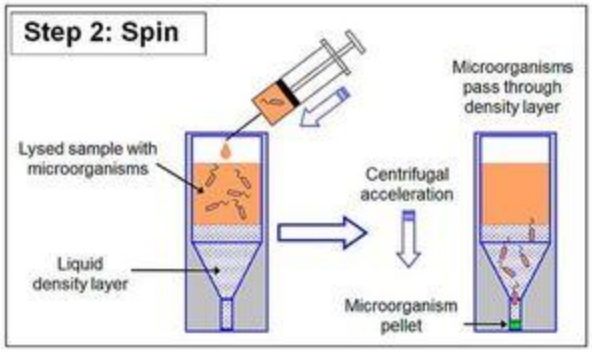
II. Self-Contained Subculture System

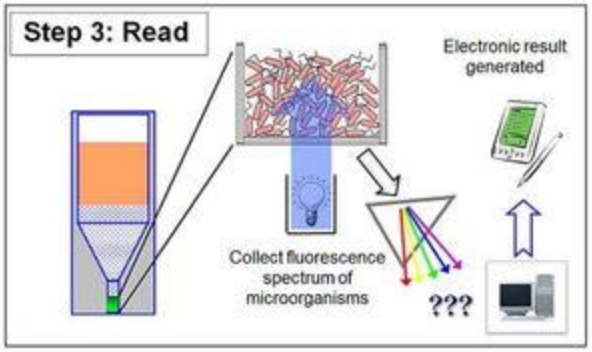
- Biphasic blood culture (The BD Septi-Chek system)
- Isolations of Fungi and Mycobacteria
- No recovery for anaerobic isolates

III. Lysis Centrifugation

- Rapid and improved recovery of filamentous fungi
- The presence of actual colonies
- Quantify the CFU
- Rapid detection of polymicrobial bacteremia
- The ability to choose special media
- Enhance recovery of intracellular microorganisms







Culture techniques

Culture techniques

IV. Instrument-based system

- The BACTEC system
- BacT/ALERT + BHI
- Versa TREK System

V. Techniques to detect IV Catheter-Associated Infections

- Semiquantitative cultures
- Gram stain of the skin entry site
- Culture of IV catheter tips

CRI:

- Differential quantitative cultures
- Differential time to positivity of blood specimens

Culture techniques

Handling positive blood culture

- Gram stain
  - Methanol fixation
  - Acridine orange (AO) staining
- Subculture
  - Chocolate agar, 5% sheep blood agar, MacConkey agar and anaerobic blood agar
- Antimicrobial susceptibility tests
- Biochemical tests
- Molecular tests
- Storage

Interpretation of the results

- Probable contaminant
  - Growth of *Bacillus* spp., *Corynebacterium* spp., *Propionibacterium* acnes, or coagulase-negative *staphylococci*
  - Growth of multiple organisms
  - The clinical presentation not consistent with sepsis
  - Organism at primary site not the same as that isolated
- Probable pathogen
  - Same organism from different sites at different time
  - Compatibility b/w The clinical presentation and isolated organism
  - Growth of *Enterobacteriaceae*, *S. pneumoniae*, *S. pyogenes* and gram negative anaerobes
  - Commensal flora in immunosuppressed patients or those having prosthetic devices