Bacteremia

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A. Definition
   - Bacteremia refers to the presence of viable bacteria in the blood that are capable of 1) infection and 2) reproduction
   - A diagnosis of bacteremia, by definition, requires positive blood cultures

B. Pathogenesis
   - Bacteremia can occur anytime bacteria are introduced into the blood stream.
   - Bacteria can be introduced either through *primary* or *secondary* processes
     - Primary bacteremia occurs when there is an injury to the barrier allowing bacteria to enter the bloodstream without an initial infectious source
       - Most common sources of primary bacteremia include:
         - Indwelling catheters
         - Intravascular devices
         - Local trauma (e.g. brushing one's teeth)
     - Secondary bacteremia occurs when an infection in the body damages the barrier allowing the bacteria to spread and propagate the infection
       - Most common sources of secondary bacteremia include:
         - Pneumonia
         - Endocarditis
         - Urinary tract infections
         - Skin and soft tissue infections
         - Bone and joint infections

C. Signs & Symptoms
   - Since bacteremia may occur commonly and transiently, it is only clinically significant when there is evidence of systemic inflammatory response to the bacteria
   - Since inflammatory signs are non-specific, history and exam should illicit information pertinent to identifying the source of the infection

D. Categorical Schema
   - Gram Positive Bacteremia:
     - Majority caused by *S. aureus*
     - Occurs more often in patients who have central venous catheters, skin infections, or a history of IV drug abuse
     - High morbidity rate (65%) due to risk of metastatic infections
     - Most common complications include endocarditis, osteomyelitis, septic arthritis, and epidural abscesses
   - Gram Negative Bacteremia:
     - Multiple potential organisms, but most common are *E. coli, Klebsiella, Enterobacter,* and *Pseudomonas*
     - Occurs more often in patients with urinary tract infections, hospital acquired pneumonia, cholangitis and other intra-abdominal infections

- High mortality rate (34%) due to risk of acute onset septic shock
  - Mortality increases every hour a patient is hypotensive without antibiotics

E. Diagnostics
- Clinical evidence of bacterial infection is present, and two blood cultures obtained from two different sites at two different times identify the same bacterial species
- Multiple methods can be used to identify cultured bacteria within a hospital lab
  - Bacteria were conventionally identified through various biochemical analyses
  - The gold standard for identification today is gene sequencing of the RNA within the small subunits of bacterial ribosomes
  - MALDI-TOF mass spectrometry is 98.3% accurate when compared to gene sequencing but it is more efficient and progressively replacing chemical tests
    - It calculates the mass to charge ratio of bacterial proteins by ionizing and accelerating them through charge repulsion then recording the flight time
    - It specifically analyzes proteins that weigh 2-20kDa which are majority ribosomal proteins and constitute the bacteria's peptide mass fingerprint

F. Treatment Regimens
- Adequate Source Control
  - Antibiotics can adequately treat the bloodstream infection but may not resolve the cause, or source, of the bacteremia
  - Treatments aimed at source control include removal of indwelling catheters/prosthetics, abscess drainage, and/or tissue debridement
  - Prolonged antibiotic courses may not be necessary in some cases once adequate source control is established
- Appropriate Antibiotic Selection
  - Given that it usually takes 3-5 days before blood cultures can prove bacteremia, antibiotics should be initiated before the diagnosis can be proven
  - Initial antibiotic treatment must be made empirically from initial Gram stain
    - Gram Positive: Vancomycin or Daptomycin for MRSA coverage
      - Cefazolin or nafcillin can be given if there is no concern for MRSA
    - Gram Negative: 2 antibiotics from different anti-pseudomonal classes
- Duration of Antibiotics
  - Therapy can be discontinued after 2 weeks if…
    - Patient is afebrile with negative blood cultures 4 days after giving first dose
    - Patient is not immunocompromised and has no metastatic infections
    - Patient has no indwelling catheters, intravascular devices, or prosthetics
  - Therapy is continued for 4-6 weeks if above criteria cannot be meet

G. Clinical Pearls
- Administration of empiric antibiotics should be performed within 1 hour of recognition of bacteremia to improve patient outcomes
- ID consultation reduces mortality for patients with staphylococcus bacteremia
- Repeat blood cultures are not necessary to follow treatment for bacteremia with gram negative rods