1. Bacteremia and Infective Endocarditis

Bacteremia and Infective Endocarditis

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2. Blood Stream Invasion: Take Home

Blood Stream Invasion: Take Home

- What is the bug?
  - Gram positive, gram negative, fungus, other
- How did it get there?
  - Is it a primary infection: direct invasion of blood
  - Is it secondary to infection at a remote site (soft tissue, lung(s), kidney, liver, GI tract etc.)
- Where did it come from?
  - Does it colonize mouth, skin, gut or other?
- Where did it go?
  - Intravascular: heart valves, major blood vessels (aorta), clot
  - Other organs; bone

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3. Blood Stream Infections: Definitions (1)

**Blood Stream Infections: Definitions**

- **Bacteremia**
  - Primary: direct invasion of the blood stream
    - Nosocomial
    - Intravenous drug use
  - Secondary: infection at another site complicated by microorganisms subsequently invading blood stream
    - Pyelonephritis – infection of kidney
    - Pneumonia
    - Skin or soft tissue infections

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4. Blood Stream Infections: Definitions (2)

**Blood Stream Infections: Definitions**

- **Infective Endocarditis (IE)**
  - Infection of endocardial surface of heart
    - Heart valves most common
  - **Terms**
    - *Acute IE*: Invasive, pathogenic organisms ⇒ toxic course
    - *Subacute IE*: more indolent course caused by less pathogenic bacteria

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5. Blood Stream Infections: Entry

**Blood Stream Infections: Entry**

- Direct inoculation
  - Vascular catheters, IVDU
  - Brushing teeth, dental work
  - Defecation

- Translocation from other infected site

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**Blood Stream Infection: Direct Inoculation**

- Skin
  - Usually gram positive organisms
    - *Staphylococci, Streptococci*

- Oral Cavity
  - Usually gram positive organisms, oral anaerobes and gram negative rods
    - *Viridans streptococci*

- Gut
  - Usually gram negative organisms
    - *Enterobacteriaceae (Escheria coli, Klebsiella pneumoniae)*

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7. Bacteremia: Clinical Manifestations (1)

Bacteremia: Clinical Manifestations

- Non-specific symptoms
  - lethargy, mental status changes in elderly particularly, nausea/vomiting
  - fever or hypothermia, sweats, chills/rigors
  - myalgias/back pain
- Symptoms related to primary site
  - skin: cellulitis, fasciitis
  - pneumonia: pleuritic CP or cough
  - pyelonephritis: back pain

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8. Bacteremia: Clinical Manifestations (2)

Bacteremia: Clinical Manifestations

- Non-specific signs
  - leukocytosis or leukopenia
  - petechial rash, purpura
  - hypotension
  - bandemia (immature polymorphonuclear cells)

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9. Bacteremia: Diagnosis (1)

**Bacteremia: Diagnosis**

- NO SINGLE BLOOD DRAW PERFORMED AS A MEDICAL STUDENT (or otherwise) IS MORE IMPORTANT THAN THE BLOOD CULTURE!!
  - Only 5%-15% positive in febrile patients
- Indications for blood cultures
  - before empiric abx in the febrile patient
  - evaluation of the extent of systemic and localized infections

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10. Bacteremia: Blood Culture Technique

**Bacteremia: Blood Culture Technique**

- Site: venipuncture is preferred or one from central line and one from vein
- Technique to minimize contamination
  - alcohol wipe then clean the skin with providone iodine - dry for 1-2 minutes
  - if need to palpate for vein, do so with sterile glove to reduce contamination rates
  - 2 sets of cultures preferred
  - minimum of 10 mL per bottle

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11. Bacteremia: Diagnosis (2)

Bacteremia: Diagnosis

- So, is it real? What is a contaminant?
  - when growth occurs after 72 h of incubation
    - CAVEAT: prior antibiotics may delay growth and some fastidious organisms will take time
  - skin organism: *P. acnes, Corynebacterium spp, Bacillus spp.*, coagulase negative *Staphylococcus*
    - CAVEAT: all of these CAN be pathogens depending on clinical setting, host etc

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12. Bacteremia Treatment Considerations

Bacteremia Treatment Considerations

- What is the bug?
  - Broad coverage until antimicrobial sensitivity known, then tailor

- Where did it come from?
  - Nosocomial gram positive cocci
    - intravascular catheter related?
      - REMOVE CATHETER
  - Nosocomial gram negative
    - ventilator associated pneumonia
    - foley associated UTI/pyelo
    - gastrointestinal catastrophe

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13. Intravascular Infection: Infective Endocarditis

Intravascular Infection: Infective Endocarditis

- Infective Endocarditis (IE)
  - Epidemiology
  - Pathogenesis
  - Clinical Manifestations
  - Diagnosis
  - Microbiology
  - Treatment

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14. Epidemiology

Epidemiology

- Incidence:
  - 1-5 cases per 1000 hospital admissions
- Age distribution:
  - >50% in patients 34-60y
- Predisposing factors:
  - Valvular heart disease
    - Rheumatic heart disease (declining in frequency)
    - Congenital heart disease
    - MVP
  - Idiopathic hypertrophic subaortic stenosis (IHSS)
  - Prosthetic devices (valves, pacemakers, CVLs)
  - Intravenous drug use (TV most common)

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15. Pathogenesis

**Pathogenesis**

![Diagram showing pathogenesis with Valvular Endothelium and Mucous Membranes, Platelet-Fibrin Deposition, Nonbacterial Thrombotic Endocarditis, Trauma, Bacteremia, Adherence, Colonization, and Vegetation=Hallmark.](c) 2004. Susan Hadley, MD

16. Consequences of Vegetation

**Consequences of Vegetation**

- Persistent bacteremia
- Host response
  - Proinflammatory cytokines
- Tissue destruction by microorganism
  - Valvular damage
- Vegetation fragmentation
  - "emboli" small or large
- Immune complex formation
  - Deposit in kidneys (glomerulonephritis)
  - Deposit in choroid plexus, spleen, skin

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17. Clinical Manifestations (1)

Clinical manifestations

- Symptoms
  - “Constitutional”
    - Chills
    - Weakness
    - Sweats
    - Anorexia/weight loss if subacute
  - Myalgia/arthralgia
  - Back Pain

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18. Clinical Manifestations (2)

Clinical Manifestations

- Signs
  - Fever most common
  - Heart murmur usual
  - Embolic phenomena
    - Cerebral, splenic, lung, skin, eye
  - Splenomegaly
  - Neurologic (hemiplegia, MS change)
  - Clubbing
  - Roth spots (oval, pale retinal lesions surrounded by hemorrhage)

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Clinical Manifestations (3)

**Clinical Manifestations**

- Mucocutaneous lesions
  - Petechiae (especially conjunctival)
  - Osler nodes (small, painful nodules on pads of fingers/toes)
  - Janeway lesions (hemorrhagic, painless macules on palms/soles)
  - Splinter hemorrhages

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Clinical Manifestations (4)

**Clinical Manifestations**

- Complications
  - Congestive heart failure (CHF)
  - Major embolic episodes (MI, PE, major CNS emboli → stroke)
  - Renal failure
  - Mycotic aneurysm – infection of artery or arteriole wall

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21. Infective Endocarditis: Diagnosis (1)

**Infective Endocarditis: Diagnosis**

- **Routine laboratory tests (nondiagnostic)**
  - Anemia of chronic disease
  - Leukocytosis
  - Elevated sedimentation rate very common
  - Abnormal urinalysis (hematuria, proteinuria)

- **Microbiology**
  - Blood culture positive in 90%
    - Most important diagnostic test
    - Less sensitive if drawn after abx
    - Obtain 3 sets in first 24 hours, hold for 3 weeks

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22. Infective Endocarditis: Diagnosis (2)

**Infective Endocarditis: Diagnosis**

- **Echocardiography**
  - Transthoracic echo (TTE)
    - ~60% sensitive for detecting vegetations
    - OK for right-sided IE
  - Transesophageal echo (TEE)
    - ~95% sensitive for detecting vegetations, also detects perivalvular abscesses
    - Preferred test for evaluation of prosthetic valves
    - Consider TEE in patients with suspected IE (even if TTE negative)

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23. Infective Endocarditis: Duke Diagnostic Criteria

Infective Endocarditis: Duke Diagnostic Criteria

- Criteria Components
  - Clinical events
  - Microbiology
  - Pathology
  - Echocardiography

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24. Differential Diagnosis

Differential Diagnosis

- Non-infectious endocarditis
  - Marantic endocarditis-paraneoplastic syndrome associated with some malignancies
  - Libman-Sacks endocarditis-associated with Systemic Lupus Erythematosus (SLE)
- Cardiac Tumors
  - Atrial myxoma most common

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25. Infective Endocarditis: Microbiology (1)

IE: Microbiology

- Bacteria ~80%
  - Streptococci and staphylococci most common
- Fungi ~3%
- Unusual organisms and "culture-negative"
  IE ~5%

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26. Infective Endocarditis: Microbiology (2)

IE: Microbiology

- Gram positive bacteria
  - Viridans streptococci (α-hemolytic)
    - Most common cause of IE
    - Includes many species: S. sanguis, S. bovis, S. mutans, etc.
    - Usually manifests as SBE
    - High cure rate, low mortality
    - Oral cavity common source

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IE: Microbiology

- Gram positive bacteria
  - *Staphylococcus aureus*
    - Second most common cause of IE
    - Usually manifests as ABE
      - Often complicated by myocardial abscess, purulent pericarditis, valve ring abscess, and peripheral foci of suppuration
    - High mortality due to fulminant infection
    - Common cause of right-sided IE in IVDU

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28. Bacteremia and Infective Endocarditis

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29. Infective Endocarditis: Microbiology (4)

IE: Microbiology

- **Gram positive bacteria**
  - **Coagulase-negative Staphylococci (ex. S. epidermidis)**
    - Most common cause of prosthetic valve IE (or PVE)
  - **Enterococci (E. faecalis and E. faecium)**
    - Third most common cause of IE
    - Usually manifests as SBE, but can also be fulminant
    - High mortality due to intrinsic antibiotic resistance

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30. Infective Endocarditis: Microbiology (5)

IE: Microbiology

- **Gram negative bacteria**
  - **HACEK group (Haemophilus, Actinobacillus, Cardiobacterium, Eikenella, Kingella)**
    - Normal flora of the oropharynx
    - Fastidious gram-negative rods, requiring up to 2-3 weeks for isolation
    - SBE presentation with large friable vegetations, frequent emboli, CHF
  - **Enteric gram-negative rods (ex. Pseudomonas aeruginosa)**
    - Rare cause of IE
    - Most cases in IVDU
    - Need for valve replacement and high mortality common with left-sided disease

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31. Infective Endocarditis: Microbiology (6)

**IE: Microbiology**

- **Fungi**
  - *Candida species, Aspergillus species*
  - Rare causes of IE
  - Most often in IVDU, PVE, or patients receiving prolonged IV antibiotics/TPN
  - Often require valve replacement for cure

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32. Infective Endocarditis: Special Considerations (1)

**Infective Endocarditis: Special Considerations**

- Prosthetic valve endocarditis
  - Infection on artificial valve
  - Early PVE
    - Occurs within first year after valve replacement
    - *Staphylococci* most common causes
  - Late PVE
    - Occurs after 1 year
    - Typical pathogens

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33. Infective Endocarditis: Special Considerations (2)

**Infective Endocarditis: Special Considerations**

- Right sided endocarditis (tricuspid)
  - Intravenous drug user
    - Most common organism is *S. aureus*, but *Pseudomonas aeruginosa* and *Candida* species may also cause infections in IVDU
  - Indwelling intravenous catheters
    - Used for chemotherapy, TPN

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34. Infective Endocarditis: Treatment (1)

**IE: Treatment**

- Antibiotic Therapy
  - aim for bactericidal regimen
- Surgical Therapy
  - indicated when severe valvular failure occurs or when peri-valvular abscess needs drainage
  - infection with resistant organism

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35. Infective Endocarditis: Treatment (2)

IE: Treatment

- Antibiotic Therapy
  - General Principles
    - Bactericidal activity
    - High antimicrobial concentrations in the vegetation
    - Frequent dosing to prevent regrowth
    - Long-term treatment (usually 4-6 weeks)

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36. Key Concepts (1)

Key Concepts

- The BUG gives clues to where it came from
  - Skin flora: Staphylococci, streptococci
  - Oral cavity: Viridans Streptococci
  - Gut flora: Enterobacteriaceae
- How it got there gives clues to where to look
  - Primary or secondary

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37. Key Concepts (2)

Key Concepts

- Where it came from gives clues to where did it go
  - Are there symptoms and signs of infective endocarditis?
  - Is there evidence of complications from a cardiac vegetation?

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