Endocarditis in the Hospitalized Setting

Endocarditis is a serious infection of the heart's inner lining, often involving the valves, with significant morbidity and mortality if untreated. This pamphlet provides students with a detailed guide to evaluate, diagnose, and treat endocarditis, including when to consult specialists, with case scenarios to apply the knowledge.

Presentation

- **Overview:** Endocarditis is an infection of the endocardium, typically involving heart valves, caused by bacteria, fungi, or other pathogens. It can be acute (rapid onset, severe) or subacute (insidious, prolonged).
- **Acute Endocarditis:**
  - **Symptoms:** High fever (T >38.5°C), chills, night sweats, fatigue, dyspnea, chest pain (embolic event), or septic shock.
  - **Onset:** Days to 1-2 weeks.
  - **Common Pathogens:** Staphylococcus aureus (aggressive, often in IV drug users), Streptococcus pneumoniae, gram-negative bacilli.
- **Subacute Endocarditis:**
  - **Symptoms:** Low-grade fever (T 38-38.5°C), fatigue, weight loss, anorexia, arthralgias, new murmur, or embolic phenomena (e.g., Janeway lesions, Osler nodes, Roth spots).
  - **Onset:** Weeks to months.
  - **Common Pathogens:** Viridans group streptococci (e.g., S. sanguinis), Enterococcus, HACEK organisms (Haemophilus, Aggregatibacter, Cardiobacterium, Eikenella, Kingella).
- **Physical Exam:**
  - **Cardiac:** New or changing murmur (e.g., mitral/aortic regurgitation), heart failure signs (JVD, crackles).
  - **Embolic Phenomena:** Janeway lesions (painless palmar macules), Osler nodes (painful fingertip nodules), Roth spots (retinal hemorrhages), splinter hemorrhages (nail bed).
  - **Systemic:** Splenomegaly, petechiae, clubbing (chronic cases), neurologic deficits (stroke from septic emboli).
- **Key Tips:**
  - Suspect endocarditis in patients with fever + new murmur or embolic signs.

- **IV drug users:** Right-sided (tricuspid) involvement → Pulmonary emboli (dyspnea, chest pain).

Causes

- **Infectious Causes:**
  - **Bacterial:**
    - **Staphylococcus aureus:** Most common in acute cases, IV drug users, prosthetic valves, nosocomial (e.g., catheter-related).
    - **Viridans Group Streptococci:** Subacute, often in patients with dental procedures, native valve disease.
    - **Enterococcus:** Elderly, post-GI/GU procedures, often with underlying valve disease.
    - **HACEK Organisms:** Subacute, fastidious gram-negatives, often in native valves.
    - **Staphylococcus epidermidis:** Prosthetic valve endocarditis (PVE), early post-surgery (<12 months).
    - **Gram-Negatives:** Pseudomonas aeruginosa, Escherichia coli (rare, often in IV drug users or nosocomial).
    - **Streptococcus bovis:** Associated with colon cancer (screen with colonoscopy).
  - **Fungal:**
    - **Candida spp.:** Immunocompromised, IV catheters, prosthetic valves, often bulky vegetations.
    - **Aspergillus spp.:** Rare, high mortality, often in neutropenic patients.
  - **Other:**
    - **Coxiella burnetii (Q fever):** Chronic, zoonotic exposure (e.g., farm animals), blood culture-negative.
    - **Bartonella spp.:** Homeless, cat exposure, culture-negative.
- **Non-Infectious Causes:**
  - **Libman-Sacks Endocarditis:** SLE, non-infectious, vegetations on mitral/tricuspid valves.
  - **Marantic Endocarditis:** Non-bacterial thrombotic endocarditis (NBTE), associated with malignancy (e.g., adenocarcinoma), hypercoagulable states.
- **Risk Factors:**
  - **Structural Heart Disease:** Bicuspid aortic valve, mitral valve prolapse, rheumatic heart disease.
  - **Prosthetic Valves:** Early PVE (<12 months: S. epidermidis); late PVE (>12 months: similar to native valve).

- **IV Drug Use:** Right-sided (tricuspid valve), S. aureus predominant.
- **Invasive Procedures:** Dental, GI/GU procedures (Enterococcus, S. bovis).
- **Immunosuppression:** Fungal endocarditis, culture-negative organisms.
- **Catheters/Pacemakers:** Nosocomial (S. aureus, S. epidermidis), device-related infections.

Diagnosis

- **Duke Criteria (Modified):**
  - **Major Criteria:**

    1. Blood Cultures: 2 separate positive cultures of typical organisms (e.g., S. aureus, viridans streptococci) OR persistently positive cultures (e.g., ≥12h apart) OR single culture positive for Coxiella burnetii.

    2. Echocardiographic Evidence: Vegetation, abscess, new dehiscence of prosthetic valve OR new valvular regurgitation.
  - **Minor Criteria:**

    1. Predisposition: IV drug use, prosthetic valve, structural heart disease.

    2. Fever: T ≥38°C.

    3. Vascular Phenomena: Septic emboli (e.g., pulmonary infarcts, Janeway lesions), mycotic aneurysm, intracranial hemorrhage.

    4. Immunologic Phenomena: Osler nodes, Roth spots, glomerulonephritis, rheumatoid factor.

    5. Microbiologic Evidence: Positive blood culture not meeting major criteria OR serologic evidence of infection (e.g., Bartonella, Coxiella)
  - **Diagnosis:**
  - **Definite:** 2 major OR 1 major + 3 minor OR 5 minor.
  - **Possible:** 1 major + 1 minor OR 3 minor.
- **Labs:**
  - **Blood Cultures:** ≥3 sets (aerobic/anaerobic) before antibiotics, 1h apart; hold for 48h if culture-negative (Coxiella, Bartonella).
  - **Inflammatory Markers:** ESR, CRP (elevated in subacute), procalcitonin (if sepsis suspected).
  - **CBC:** Anemia (chronic disease), leukocytosis (acute), thrombocytopenia (sepsis, DIC).
  - **Renal Function:** Creatinine (glomerulonephritis), urinalysis (hematuria, proteinuria).

    - **Serologies:** Coxiella burnetii (Q fever), Bartonella (if culture-negative), rheumatoid factor (immunologic).
- **Imaging:**
    - **Transthoracic Echocardiogram (TTE):** First-line, sensitivity 60-70% for vegetations.
    - **Transesophageal Echocardiogram (TEE):** Sensitivity 90-100%, preferred for prosthetic valves, abscess, or if TTE negative.
    - **CT/MRI:** Detect embolic events (e.g., stroke, splenic abscess), mycotic aneurysms.
    - **Chest X-ray:** Pulmonary emboli (right-sided endocarditis), heart failure (left-sided).
- **Key Tips:**
    - TEE if TTE negative but high suspicion (e.g., prosthetic valve, IV drug user).
    - **Culture-negative endocarditis:** Consider Coxiella, Bartonella, or prior antibiotics—send serologies.

Diagnostic Criteria Table

Category	Criteria Details	Notes
Major Criteria	Blood cultures, echocardiography	2 positive cultures (S. aureus)Vegetation on echo Single culture for Coxiella burnetii counts as major.
Minor Criteria	Predisposition, fever, embolic	IV drug useT ≥38°CJaneway lesions Need 3 minor if only 1 major present.
Definite Endocarditis	Diagnostic threshold	2 major OR 1 major + 3 minor Possible: 1 major + 1 minor OR 3 minor.

Treatment

- **Antibiotics (Empiric Therapy):**
    - **Native Valve (Acute):** Vancomycin 15 mg/kg IV q12h + ceftriaxone 2 g IV q24h (covers S. aureus, streptococci, gram-negatives).
    - **Prosthetic Valve:** Vancomycin 15 mg/kg IV q12h + gentamicin 1 mg/kg IV q8h + rifampin 300 mg PO/IV q8h (covers S. epidermidis, gram-negatives).
    - **Culture-Negative:** Vancomycin 15 mg/kg IV q12h + doxycycline 100 mg IV q12h (covers Coxiella, Bartonella).
- **Directed Therapy (Based on Culture/Susceptibility):**
    - **S. aureus (MSSA):** Nafcillin 2 g IV q4h x 6 weeks (native valve); add gentamicin 1 mg/kg IV q8h x 2 weeks (prosthetic valve).
    - **S. aureus (MRSA):** Vancomycin 15 mg/kg IV q12h x 6 weeks.

    - **Viridans Streptococci:** Penicillin G 24 million units IV daily (divided q4-6h) OR ceftriaxone 2 g IV q24h x 4 weeks.
    - **Enterococcus:** Ampicillin 2 g IV q4h + gentamicin 1 mg/kg IV q8h x 4-6 weeks (if susceptible).
    - **HACEK:** Ceftriaxone 2 g IV q24h x 4 weeks.
    - **Fungal (Candida):** Amphotericin B 0.5-1 mg/kg IV daily + flucytosine 25 mg/kg PO q6h x 6 weeks; surgical valve replacement often required.
- **Surgical Indications:**
    - Heart failure (severe regurgitation, refractory).
    - Persistent infection (>7-10 days despite antibiotics).
    - Large vegetations (>10 mm, embolic risk).
    - Abscess, prosthetic valve dehiscence, or fungal endocarditis.
- **Supportive Care:**
    - **Monitor for heart failure:** Daily exam (murmur, JVD), chest X-ray, diuretics if needed (furosemide 40 mg IV).
    - **Embolic events:** CT/MRI for stroke, splenic abscess; anticoagulation if indicated (e.g., septic pulmonary emboli).
- **Key Tips:**
    - **Duration:** 4-6 weeks IV antibiotics; prosthetic valves often require 6 weeks.
    - Monitor vancomycin levels (trough 15-20 µg/mL for MRSA).

Management Guidelines Table

Pathogen	Treatment Agent/ Dose	Notes
S. aureus (MSSA)	Nafcillin, gentamicin (prosthetic)	Nafcillin 2 g IV q4h x 6 weeksd Gentamicin x 2 weeks for prosthetic valves.
Viridans Streptococci	Penicillin OR ceftriaxone	Penicillin G 24 million units IV daily x 4 weeks Ceftriaxone alternative if penicillin-allergic.
Fungal (Candida)	Amphotericin B, flucytosine	Amphotericin B 0.5-1 mg/kg IV daily Surgical valve replacement often required.
Culture-Negative	Vancomycin, doxycycline	Vancomycin 15 mg/kg IV q12h Covers Coxiella, Bartonella; monitor trough.

Complications

- **Acute:**
    - **Heart Failure:** 20-40% of cases; most common cause of death (severe regurgitation, valve destruction).
    - **Embolic Events:** Stroke (15-20%), splenic abscess, pulmonary emboli (right-sided), mycotic aneurysm.

    - **Sepsis:** Septic shock, multi-organ failure (S. aureus, gram-negatives).
- **Chronic:**
    - **Valvular Dysfunction:** Chronic regurgitation, heart failure (post-treatment).
    - **Renal Failure:** Glomerulonephritis (immune complex deposition), AKI (sepsis, antibiotics).
- **Other:**
    - **Abscess:** Perivalvular, myocardial (prosthetic valves, S. aureus).
    - **Prosthetic Valve Failure:** Dehiscence, obstruction (early PVE).

When to Consult Infectious Disease (ID) and Cardiology

- Cases usually ALWAYS involve consulting both cardiology and infectious disease, but especially in the following scenarios:
    - Culture-negative endocarditis (e.g., Coxiella, Bartonella).
    - Fungal endocarditis (Candida, Aspergillus—high mortality, complex management).
    - Persistent bacteremia (>7 days despite antibiotics).
    - Nosocomial endocarditis (e.g., catheter-related, prosthetic valve).
    - Antibiotic resistance (e.g., MRSA, VRE) or complex regimens (e.g., Enterococcus).
- **Cardiology:**
    - New or worsening heart failure (e.g., new murmur, JVD, crackles).
    - **Echocardiographic findings:** Vegetation >10 mm, abscess, prosthetic valve dehiscence.
    - **Surgical indications:** Heart failure, persistent infection, embolic risk.
    - Right-sided endocarditis with pulmonary emboli (IV drug users).
    - Need for pacemaker/ICD removal (device-related endocarditis).

Key Pearls

- Suspect endocarditis in fever + new murmur, embolic phenomena, or IV drug use (right-sided).
- **Duke Criteria:** 2 major (blood cultures, echo) OR 1 major + 3 minor for definite diagnosis.
- **Blood Cultures:** ≥3 sets before antibiotics; culture-negative → Serologies (Coxiella, Bartonella).
- **TEE:** Preferred for prosthetic valves, abscess, or if TTE negative but high suspicion.

- **Antibiotics:** 4-6 weeks IV; S. aureus (nafcillin/vancomycin), viridans (penicillin/ceftriaxone), fungal (amphotericin + surgery).
- **Surgery:** Heart failure, persistent infection, large vegetations (>10 mm), abscess.

References

- **UpToDate:** “Infective Endocarditis: Diagnosis and Management” (2025).
- **AHA:** “Guidelines for the Management of Infective Endocarditis” (2024).
- **NEJM:** “Infective Endocarditis: Clinical Features and Outcomes” (2023).
- **Clin Infect Dis:** “Fungal Endocarditis: Diagnosis and Treatment” (2024).

Case Scenarios

Case 1: A 35-Year-Old Male with IV Drug Use

- **Presentation:** A 35-year-old male with IV drug use presents with fever (39°C), dyspnea, and chest pain for 3 days. Exam shows a tricuspid regurgitation murmur, crackles in the right lung, and needle tracks on his arms.
- **Labs/Imaging:** WBC 15,000/µL, 3/3 blood cultures positive for S. aureus (MSSA). TTE: 12 mm vegetation on tricuspid valve. Chest X-ray: Multiple pulmonary nodules (septic emboli).
- **Diagnosis:** Definite Endocarditis → 2 major (blood cultures, echo), IV drug use (minor).
- **Management:** ID consult. Start nafcillin 2 g IV q4h x 6 weeks. Monitor for heart failure (daily exam, chest X-ray). CT chest confirms pulmonary emboli—no anticoagulation (septic emboli). Cardiology consult for vegetation size (>10 mm, embolic risk). Patient improves, discharged on IV antibiotics via PICC line.

Case 2: A 65-Year-Old Female with Prosthetic Valve

- **Presentation:** A 65-year-old female with a prosthetic aortic valve (3 months post-op) presents with fever (38.5°C) and fatigue for 2 weeks. Exam shows a new aortic regurgitation murmur, no embolic signs.
- **Labs/Imaging:** WBC 12,000/µL, 2/2 blood cultures positive for S. epidermidis. TEE: Prosthetic valve dehiscence, 8 mm vegetation. ESR/CRP elevated.
- **Diagnosis:** Definite Endocarditis → 2 major (blood cultures, echo), prosthetic valve (minor).

- **Management:** ID and cardiology consult. Start vancomycin 15 mg/kg IV q12h + gentamicin 1 mg/kg IV q8h + rifampin 300 mg PO q8h x 6 weeks. Monitor vancomycin trough (15-20 µg/mL). Surgical evaluation for dehiscence—valve replacement performed on day 5. Continue antibiotics post-op, monitor for heart failure.

Case 3: A 50-Year-Old Male with Subacute Symptoms

- **Presentation:** A 50-year-old male with a history of dental surgery 6 weeks ago presents with low-grade fever (38°C), weight loss, and fatigue. Exam shows a new mitral regurgitation murmur, splenomegaly, and Roth spots.
- **Labs/Imaging:** WBC 9,000/µL, 2/2 blood cultures positive for viridans streptococci (S. sanguinis). TTE: 6 mm vegetation on mitral valve. Urinalysis: Hematuria (glomerulonephritis). ESR/CRP elevated.
- **Diagnosis:** Definite Endocarditis → 2 major (blood cultures, echo), 2 minor (fever, immunologic).
- **Management:** ID consult. Start ceftriaxone 2 g IV q24h x 4 weeks (penicillin-susceptible). Monitor for heart failure (daily exam). No surgical indications (vegetation <10 mm, no heart failure). Order colonoscopy (S. bovis association—negative). Patient completes therapy, murmur stable at follow-up.