INFECTIVE ENDOCARDITIS: DIAGNOSIS AND ANTIBIOTIC THERAPY

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Abstract: Infective endocarditis (IE) remains a severe and potentially life-threatening infection of the endocardial surface of the heart, primarily affecting the cardiac valves. Despite advancements in medical technology, IE continues to carry high rates of morbidity and mortality due to severe complications like embolic events, heart failure, and the difficulty of eradicating pathogens embedded within protective vegetations and biofilms. This review comprehensively synthesizes current standards in the clinical diagnosis and management of IE. It focuses on the application of the Modified Duke Criteria, which integrate microbiological and echocardiographic evidence, and underlines the crucial roles of blood cultures and transesophageal echocardiography (TEE). Furthermore, the article provides evidence-based approaches to both empiric and pathogen-directed intravenous antibiotic therapies, carefully differentiating management strategies between native and prosthetic valve infections while addressing common pathogens, multi-drug resistance patterns, and the vital role of multidisciplinary team care.

Keywords: Infective endocarditis, Modified Duke Criteria, blood cultures, echocardiography, empiric antibiotic therapy, native valve endocarditis, prosthetic valve endocarditis, vegetations.

Infective endocarditis (IE) remains a serious and potentially fatal disease characterized by infection of the endocardial surface of the heart, most commonly involving the cardiac valves. Despite advances in diagnostic imaging, microbiology, and antimicrobial therapy, IE continues to carry substantial morbidity and mortality due to embolic complications, heart failure, and difficulties eradicating organisms entrenched within vegetations. This review summarizes current standards for diagnosis,

highlights the Modified Duke Criteria and the role of blood cultures and echocardiography, and presents evidence-based approaches to empiric and targeted intravenous antibiotic therapy for native and prosthetic valve infections, with attention to common pathogens, resistance patterns, and practical management considerations.

Pathogenesis typically requires endothelial damage or an abnormal valve surface, deposition of platelets and fibrin forming sterile thrombotic vegetations, and subsequent bacteremia seeding these vegetations. Within vegetations bacteria are partially protected from host immune responses and from some antimicrobials, necessitating prolonged bactericidal therapy. Biofilm formation on prosthetic material further complicates eradication and often mandates combined medical and surgical strategies.Clinical manifestations range from subacute presentations with fever, malaise, weight loss, and new or changing murmurs, to fulminant sepsis with acute valvular destruction and heart failure. Classic peripheral signs (Osler nodes, Janeway lesions, splinter hemorrhages, and Roth spots) are specific but insensitive. Embolic phenomena can affect virtually any organ—cerebral, renal, splenic, pulmonary (particularly with right-sided IE), and peripheral arterial emboli—contributing to morbidity. Immune-mediated phenomena such as glomerulonephritis and positive rheumatoid factor may occur. Complications include valvular insufficiency and heart failure, perivalvular abscess formation, conduction disturbances, persistent bacteremia,

Accurate and timely diagnosis of IE is critical to guide appropriate management. The Modified Duke Criteria remain the most widely used clinical tool to integrate microbiologic, echocardiographic, and clinical evidence. A definitive diagnosis is made by meeting either two major criteria, one major and three minor criteria, or five minor criteria.

Major criteria include:

- Positive blood cultures consistent with IE: typically at least two separate blood cultures yielding typical microorganisms (e.g., Staphylococcus aureus, viridans

streptococci, enterococci) or persistently positive blood cultures. Organisms such as Coxiella burnetii and Bartonella species also meet special consideration.

- Evidence of endocardial involvement on echocardiography: demonstration of vegetation, abscess, or new partial dehiscence of a prosthetic valve on transthoracic (TTE) or transesophageal echocardiogram (TEE).

Minor criteria include:

- Predisposing heart condition or injection drug use.
- Fever >38.0°C.
- Vascular phenomena (e.g., arterial emboli, septic pulmonary infarcts, mycotic aneurysm, Janeway lesions).
- Immunologic phenomena (e.g., glomerulonephritis, Osler nodes, Roth spots, rheumatoid factor).
- Microbiological evidence not meeting major criteria (e.g., single positive blood culture for a typical organism or serologic evidence).

Practical diagnostic steps

- Blood cultures: Obtain at least three sets of blood cultures from separate venipuncture sites, ideally spaced over several hours (commonly 12 hours when time allows) and obtained prior to initiation of antibiotics. Rapid collection is acceptable when clinical urgency requires prompt therapy, but whenever possible collect multiple sets before administering antimicrobials to maximize yield. Culture-negative endocarditis requires consideration of fastidious organisms (Coxiella, Bartonella, HACEK organisms) and prior antibiotic exposure—serologies, nucleic acid testing, and specialized culture methods may be required.
- Echocardiography: TTE is often the initial imaging study; however, TEE offers higher sensitivity for detecting vegetations, prosthetic valve complications, small lesions, and perivalvular abscesses and is indicated when TTE is nondiagnostic but clinical suspicion remains moderate to high, or when prosthetic valves or

intracardiac devices are present. Serial echocardiography may be required to evaluate progression, embolic risk, or response to therapy.

- Adjunctive investigations: CT or MRI for suspected embolic complications (e.g., cerebral infarction), PET-CT to detect occult infection or prosthetic valve infection in certain centers, and serologic or molecular testing for culture-negative etiologies.

Empiric antibiotic therapy: principles and regimens Empiric therapy for suspected IE should be initiated promptly in acutely ill patients after obtaining blood cultures; the regimen should provide bactericidal activity and cover likely organisms based on clinical context (native vs prosthetic valve, community-acquired vs healthcare-associated infection, intravenous drug use, local resistance patterns). Therapy must be individualized by local epidemiology and patient-specific factors (allergies, renal function, drug interactions). The rationale for broad empiric coverage is the high morbidity associated with delays in effective therapy.

For many community-acquired native valve cases in hemodynamically stable patients without recent healthcare exposure, empiric coverage targeting streptococci, methicillin-susceptible staphylococci, and enterococci is often appropriate. Common empiric options include:

- Ampicillin-sulbactam combined with gentamicin, or
- Ceftriaxone combined with gentamicin.

These combinations provide broad Gram-positive and some Gram-negative coverage; gentamicin is used for synergy in early therapy in certain regimens and to cover enterococci in combination with a cell-wall agent when indicated. However, routine addition of gentamicin should be carefully weighed against nephrotoxicity risk and evolving evidence supporting alternative regimens (e.g., beta-lactam monotherapy in some streptococcal infections).

Prosthetic valve or healthcare-associated IE Prosthetic valve endocarditis and healthcare-associated IE carry a higher likelihood of MRSA, CoNS, and resistant Gram-negative organisms. Empiric regimens should be broader:

- Vancomycin plus gentamicin plus either cefepime or a carbapenem (e.g., meropenem).

Vancomycin covers MRSA and many Gram-positive pathogens, gentamicin provides synergistic activity against staphylococci and enterococci and enhances gram-negative coverage when used with a broad-spectrum beta-lactam, while cefepime or a carbapenem covers resistant Gram-negative organisms, including Pseudomonas in institutions where this is a concern. In settings with high prevalence of MRSA and multidrug-resistant Gram-negative organisms, local antimicrobial stewardship teams should guide empiric choices.

Right-sided IE (tricuspid valve), commonly associated with S. aureus in injection drug users, may sometimes be treated with a shorter course if uncomplicated; empiric therapy should include anti-staphylococcal coverage (vancomycin for MRSA coverage until susceptibilities known). Surgical indications differ from left-sided disease and many cases respond to antibiotics alone.

Mortality in IE varies by causative organism, patient age, comorbidities, and promptness of appropriate therapy. S. aureus, fungal organisms, and Gram-negative infections are associated with worse prognosis. Delays in diagnosis, inadequate initial antimicrobial coverage, embolic events, and heart failure increase the risk of poor outcomes. Multidisciplinary care—infectious diseases, cardiology, cardiac surgery, microbiology, and sometimes neurology and nephrology—improves diagnostic accuracy and optimizes management decisions.

Emerging considerations and future directions

- Molecular diagnostics and metagenomic sequencing offer promise in diagnosing culture-negative endocarditis and identifying fastidious organisms more rapidly than traditional culture methods, potentially enabling earlier pathogen-directed therapy.
- Use of PET-CT and advanced imaging may improve detection of prosthetic valve endocarditis and perivalvular complications.
- Novel antimicrobials and combinations are being evaluated to address resistant organisms, including MRSA and VRE, and to better penetrate biofilms.
- Strategies to prevent healthcare-associated bacteremia—strict aseptic technique for intravascular devices, prompt removal of unnecessary lines, and antibiotic stewardship—remain essential to reduce the incidence of IE in hospitalized populations.
- Optimizing outpatient parenteral antibiotic therapy (OPAT) programs and exploring long-acting agents or oral step-down regimens for selected patients could reduce hospital stays while maintaining efficacy.

Infective endocarditis is a complex infection requiring timely integration of clinical assessment, microbiology, and imaging. The Modified Duke Criteria provide a structured diagnostic framework, while prompt collection of multiple blood cultures and appropriate use of echocardiography—preferably TEE when suspicion is high—are central to establishing the diagnosis. Empiric intravenous antibiotic therapy must be initiated rapidly in acutely ill patients and tailored to the clinical context, with regimens differing for native versus prosthetic valve disease and for community- versus healthcare-associated infections. Definitive therapy is dictated by organism identification and susceptibility, with prolonged bactericidal intravenous regimens (commonly 4–6 weeks) necessary to eradicate pathogens within vegetations. Multidisciplinary care, adherence to antimicrobial stewardship, and consideration of surgical intervention when indicated are essential components of successful

management. Ongoing advances in diagnostic technologies, antimicrobial agents, and strategies to address biofilm-associated infections hold promise to improve outcomes in this challenging disease.

REFERENCES

1. Habib G, Lancellotti P, Antunes MJ, et al. 2015 ESC Guidelines for the management of infective endocarditis. European Heart Journal. 2015;36(44):3075–3128.
2. Baddour LM, Wilson WR, Bayer AS, et al. Infective Endocarditis in Adults: Diagnosis, Antimicrobial Therapy, and Management of Complications. Circulation. 2015;132(15):1435–1486.
3. Cahill TJ, Prendergast BD. Infective endocarditis. Lancet. 2016;387(10021):882–893.
4. Chambers HF, Morris J, Arroliga AC. Infective Endocarditis: Pathogenesis, Diagnosis, and Treatment. In: Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases. 9th ed.
5. Murdoch DR, Corey GR, Hoen B, et al. Clinical presentation, etiology, and outcome of infective endocarditis in the 21st century: the International Collaboration on Endocarditis–Prospective Cohort Study. Arch Intern Med. 2009;169(5):463–473.