Infective Endocarditis (IE)

Definition: Infective endocarditis (IE) is an inflammation of the endocardium, the innermost layer of the heart and the lining of heart valves.

Primary Cause: Usually microbial infection, but there are also non-infectious types, such as NBTE (Non-Bacterial Thrombotic Endocarditis).

Historical Context: Once termed "bacterial endocarditis" until it was found fungi and non-bacterial agents could cause similar conditions.

Three Independent Predisposing Factors for IE:

1. Transient Bacteremia:
Can be nosocomial (hospital-acquired) or induced by invasive medical procedures or inappropriate antibiotic use.
Preventive antibiotics are often prescribed when IE risk is identified.

2. Structural Heart Defects:
Defects can allow bacteria to adhere to and colonize the heart.

3. Vegetation Formation:
Infected areas become encapsulated by a fibrin clot, cutting off blood supply, making it a metabolically inactive infection resistant to immune clearance.

IE as a Rare, Life-threatening Disease:
It has long-term effects on survivors and is deadly without treatment.
Can involve multiple organ systems and become fatal if untreated.
Dental Prophylaxis: Antibiotics are commonly prescribed before dental procedures to prevent oral flora from entering the bloodstream.

Epidemiology

Incidence: Roughly 1-10 cases per 100,000 person-years.

Risk Factors by Region:
Low-income countries: Rheumatic heart disease remains a primary risk factor (up to two-thirds of cases).
High-income countries: Degenerative valve disease, diabetes, cancer, intravenous drug use, and congenital heart disease are now leading risk factors.

Age Trends:
Mean patient age has increased (now >50 years), likely due to improved health and longevity.

Mortality:
High mortality if untreated; even with treatment, IE has about a 25% mortality rate.

Causative Agents of IE

Predominant Organisms:
Gram-positive cocci account for over 90% of cases worldwide.
Developed countries: Staphylococcus aureus is most common.
Developing countries: Streptococcus viridans is more frequent.
Enterococci (e.g., E. faecalis, E. faecium) and Streptococcus bovis account for 5-10% of cases.

Prosthetic Valves:
Common infection site; infections often by S. aureus.

IV Drug Use: Right-sided (tricuspid) valve IE is common in IV drug users.

Predisposing Factors for Endocarditis

Historical Factor: Rheumatic disease, caused by Group A Streptococcus pyogenes, commonly seen in children after strep throat.
Modern Factors:
Congenital heart disease, prosthetic heart valves, pacemakers, post-pneumonia/meningitis.
Periodontal disease or dental procedures.
Medical procedures (e.g., dental extractions, implants, hemodialysis, cystoscopy, colonoscopy).
Infections in IV Drug Users: Infections from skin or mucosal flora introduced to the bloodstream.

Microbiology Overview
Key Bacterial Causes:
Staphylococcus and Streptococcus species are responsible for ~80% of IE cases.

Staphylococcus aureus:
Most common cause in high-income countries and common in IV drug users.

Other Bacterial Groups:
HACEK group (Haemophilus, Aggregatibacter, Cardiobacterium, Eikenella, Kingella): Rare, healthcare-associated, Gram-negative organisms.

Fungal Causes (e.g., Candida albicans, Aspergillus): Rare but severe, typically in hospitalized or immunosuppressed patients.

Microbiological Differentiation:
Staphylococcus vs. Streptococcus:
Catalase test: Staphylococcus (+), Streptococcus (-).
Staphylococcus species are further classified by coagulase (e.g., S. aureus is coagulase-positive).

Types of IE in Prosthetic Valve Patients:

1. Early (within 1 month post-surgery): Commonly due to coagulase-negative Staphylococcus species, like S. epidermidis.

2. Late (after 1 month): Primarily due to S. aureus.

Microbial Causes Summary

Gram-positive Cocci: Common pathogens include Staphylococcus, Streptococcus, Enterococcus.

Viridans streptococci (oral flora) frequently cause IE in developing regions.

Fungal Endocarditis:
Often related to Candida, especially in catheterized or immunosuppressed patients.
Diagnosed through culturing on specific media (e.g., Sabouraud dextrose agar).

Yeast and Pseudohyphae:
Candida can exist in both yeast and pseudohyphal forms, depending on the environment.

Pathophysiology of IE

Mechanism:
Bacteria enter the bloodstream, adhere to altered heart valves, and form vegetations (biofilms).
Vegetations can cause septic emboli, ischemia, or infarction in various organs.

Clinical Significance:
Biofilms protect bacteria from the immune system and require prolonged IV antibiotic therapy for effective treatment.

Clinical Features

Diverse and Non-specific Presentation:
IE diagnosis is often delayed due to its non-specific symptoms.

Acute IE: Rapidly damages cardiac structures and is often fatal within weeks if untreated.

Subacute IE: Progresses slowly unless complicated by major embolic event or ruptured mycotic aneurysm, rarely metastasizes, and can take months to develop complications.

Key Indicators:
Fever of unknown origin with a new or changing heart murmur suggests IE until proven otherwise.

Manifestations:

Cardiac:
Heart murmurs, valvular damage, congestive heart failure in 30-40% of cases.

Noncardiac:
Janeway Lesions: Painless, due to septic emboli.
Osler's Nodes: Painful, immune-mediated.
Subungual Hemorrhage and conjuctival Hemorrhage: Signs of vascular involvement.
Roth's Spots: retinal hemorrhages with clear centers, an immunologic phenomenon.

Diagnosis
Core Diagnostic Tools:
Blood Culture: Essential first step; IE typically causes continuous bacteremia.
Echocardiography: Should be done for all suspected IE cases.

Modified Duke Criteria:
Combines pathologic, major, and minor criteria for diagnosis:

Pathologic: Microorganisms identified in vegetations.
Major: Positive blood cultures and endocardial involvement on imaging.
Minor: Fever, predisposing heart condition, vascular phenomena, immunologic phenomena, microbiologic evidence.

Diagnosis Confirmation:
Requires combinations of criteria: 1 pathologic or 2 major, or 1 major + 3 minor, or all 5 minor criteria.

Management

Antimicrobial Therapy:
Vancomycin and Gentamicin should be initiated immediately after blood culture.
Prolonged IV therapy often required due to biofilm complications.

Surgical Treatment:
Corrective surgery may be necessary for cardiac defects to prevent future IE episodes.

Prevention

Antibiotic Prophylaxis:
Previously recommended for many procedures; now typically reserved for high-risk patients.
Policies vary by country (e.g., the UK restricts prophylaxis to high-risk patients).