Endocarditis

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🏵️ Definition

Endocarditis is an *infection of the endocardial surface of the heart,* primarily involving heart valves (native or prosthetic).

The infection leads to formation of vegetations composed of platelets, fibrin, microorganisms, and inflammatory cells.

👉 Key outcomes:

- Valve destruction → Valvular regurgitation
- Myocardial invasion → Abscesses and conduction defects
- Embolization → Infarcts or metastatic infections
- Immune complex deposition → Extra-cardiac manifestations

Artificial cardiac materials such as prosthetic valves, pacemakers, and defibrillators provide ideal surfaces for bacterial colonization.

⚙ Pathogenesis of Endocarditis

1. Formation of NBTE (Nonbacterial Thrombotic Endocarditis)

- Minor endothelial injury → Deposition of platelets & fibrin → Small sterile vegetations

2. Transient Bacteremia

- Bacteria enter bloodstream (e.g., from dental procedure, IV drug use, catheter).

3. Adherence of Bacteria

- Circulating bacteria adhere to fibrin-platelet vegetations on the valve.

4. Bacterial Proliferation & Vegetation Growth

- Organisms multiply → Vegetation enlarges → Valve destruction & embolization

🧭 Flowchart: Pathogenesis of Infective Endocarditis

Endothelial injury → Formation of NBTE → Bacteremia → Bacterial adherence →

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Bacterial proliferation → Vegetation formation →

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Valve destruction & emboli → Clinical complications (regurgitation, infarcts, abscesses)

💥 Clinical Manifestations

Symptoms depend on:

- ⏱️ Course of infection:

- Acute Endocarditis (days): *Staphylococcus aureus*
- Subacute Endocarditis (weeks–months): *Viridans streptococci*

🩺 A. Constitutional Symptoms

Common in >80% cases:

- Fever 🌡️
- Chills
- Night sweats
- Fatigue, malaise
- Anorexia, weight loss

♡ B. Cardiac Manifestations

- New or changing murmur → due to valve destruction
- Heart failure → secondary to severe regurgitation
- Atrioventricular (AV) block → indicates septal abscess (seen as PR prolongation on ECG)

C. Embolic Phenomena

Type	Site	Clinical Effects

Left-sided endocarditis	Brain	CVA or brain abscess 🧠
	Spleen / Kidney	Infarcts → abdominal or flank pain
	Skin	Splinter hemorrhages, Janeway lesions
	Eye	Retinal & conjunctival hemorrhages
Right-sided endocarditis	Lungs	Septic pulmonary emboli → cough, chest pain, hemoptysis

⚖️ D. Immune Complex–Mediated Manifestations

Mechanism	Clinical Finding	Description
Antigen–antibody deposition	Osler's nodes	Painful nodules on fingers/toes
	Roth's spots	Retinal hemorrhages with pale centers
	Glomerulo nephritis	Hematuria, renal dysfunction
	Arthritis	Joint pain due to immune inflammation

🧠 Summary Chart: Acute vs Subacute Endocarditis

Feature	Acute	Subacute
Causative agent	*Staphylococcus aureus*	*Viridans streptococci*
Onset	Rapid (days)	Slow (weeks–months)
Valve type	Normal	Damaged/abnormal
Course	Severe, destructive	Indolent, prolonged
Complications	Early heart failure, emboli	Immune phenomena

Pathogens

Bacteria are the most common cause of endocarditis, though fungi (especially *Candida* species) can also be involved.

Modern classification divides causes into two main categories 👇

◈ 1. Native Valve Endocarditis (NVE)

Setting	Common	Notes / Associations

	Pathogen	
Community-acquired	*Viridans group streptococci*	Most common in normal or damaged native valves 🦷 (often post-dental procedure)
Healthcare-associated / IV drug users	*Staphylococcus aureus*	Rapidly progressive & destructive (acute endocarditis)
Associated with GI lesions	*Streptococcus bovis* (now *S. gallolyticus*)	Associated with colorectal carcinoma — colonoscopy recommended 🔍
Elderly / hospitalized	*Enterococcus* species	From genitourinary or abdominal sources

◈ 2. Prosthetic Valve / Device-Associated Endocarditis (PVE)

Setting	Common Pathogen	Notes
Early-onset (<2 months post-surgery)	*Staphylococcus epidermidis, S. aureus*	Coagulase-negative staphylococci dominate; often from surgical contamination
Late-onset (>2 months)	*Viridans streptococci, Enterococcus, HACEK group*	Similar to native valve infection
Implanted	*Staphylococcus*	Biofilm formation common ⚙

devices (pacemaker/ defibrillator)	*epidermidis*

🧫 Other Important Pathogens

Category	Examples	Notes
β-hemolytic streptococci	*S. pyogenes, S. agalactiae*	Less common but aggressive
HACEK group	*Haemophilus, Aggregatibacter, Cardiobacterium, Eikenella, Kingella*	Slow growers; oropharyngeal flora 😬
Fungi	*Candida species*	Seen in IV drug users, immunocompromised, or post-surgery
Culture-negative organisms	*Bartonella, Coxiella burnetii, Brucella, Tropheryma whipplei*	Require special tests (serology / PCR)

🧫 Most common reason for "culture-negative" endocarditis:

👉 *Prior antibiotic use before drawing blood cultures.*

Flowchart: Classification of Pathogens

Native Valve → (Community: *Viridans streptococci*)

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Healthcare / IV drug use → *S. aureus*

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GI source → *S. bovis*
GU source → *Enterococcus*
Prosthetic Valve / Device → *S. epidermidis, S. aureus*

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Others → HACEK / Fungi / Culture-negative organisms

Diagnosis

A definitive diagnosis ideally requires pathologic and microbiologic confirmation of valve tissue — but since this is rarely available, diagnosis relies on blood cultures + echocardiographic findings, interpreted using the Modified Duke Criteria ⚖️

🧫 1. Blood Cultures

- Obtain 3 separate sets from different venipuncture sites over at least 1 hour ⏱️
- Always before starting antibiotics!
- Yields organism in >90% of untreated cases.
- If blood cultures remain negative → think of Bartonella, Coxiella, Brucella, etc., and use serology or PCR.

2. Echocardiography

Test	Sensitivity	Notes
TTE (Transthoracic Echo)	~60%	First-line, noninvasive
TEE (Transesophageal Echo)	>90%	Gold standard for detecting vegetations, abscesses, prosthetic valve infections

Findings:

- Vegetations on valves 🌿
- Valve perforation or abscess
- Perivalvular extension of infection

📈 3. ECG Findings

- PR interval prolongation → suggests aortic valve endocarditis with perivalvular abscess.

⚖️ 4. Modified Duke Criteria (Summary)

Category	Examples
Major Criteria	Positive blood cultures for typical organisms; Echocardiographic evidence (vegetation, abscess, new regurgitation)
Minor Criteria	Predisposing condition (IV drug use, heart disease), fever, vascular phenomena, immunologic phenomena (Osler's nodes, Roth's spots), microbiologic evidence not meeting major criteria

✅ Definite Diagnosis:

- 2 Major criteria, OR
- 1 Major + 3 Minor, OR
- 5 Minor criteria

💊 Treatment

Without treatment, infective endocarditis is always fatal ⚠
Hence, prompt, bactericidal, and prolonged therapy is essential.

🧬 1. Empiric Therapy

Used when:

- Hemodynamic instability 💔
- Severe disease
- Evidence of embolic phenomena
- Large vegetations

Empiric regimen (covers MRSA, Streptococci, Enterococci, HACEK):

➡️ Vancomycin + Ceftriaxone / Gentamicin

🧫 2. Targeted Therapy

Once pathogen and sensitivities are known, modify

accordingly.
Treatment duration: 4–6 weeks of intravenous therapy.

3. Surgical Management

Indications for surgery :

- Severe heart failure due to valvular dysfunction
- Perivalvular abscess
- Persistent infection despite appropriate antibiotics
- Recurrent emboli with large vegetations

Prevention

Antibiotic prophylaxis is advised for high-risk patients undergoing certain invasive procedures.

High-risk group	Examples of Procedures Requiring Prophylaxis
Prior infective endocarditis	Dental procedures involving manipulation

of gingiva 🦷

Prosthetic heart valve	Surgery of infected tissues
Certain congenital heart diseases	Procedures involving respiratory mucosa

Preferred prophylactic agent:

☐ → Amoxicillin (oral), given before the procedure.

🧠 Quick Recap Flowchart

Predisposing valve lesion / prosthetic device

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Bacteremia (dental, IV, catheter)

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Bacterial adherence → Vegetation formation

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Valve destruction → Embolization / Abscess / Heart failure

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Diagnosis (Blood culture + Echo)

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Treatment (Empiric → Targeted ± Surgery)

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Prevention (Prophylaxis for high-risk patients)

⏱ Summary tables

Etiology of Infective Endocarditis by Category

Category	Common Pathogens	Notes / Associations
Native Valve – Community Onset	*Viridans group streptococci*, *Staphylococcus aureus*, *Streptococcus bovis*, *Enterococcus* spp.	*Viridans streptococci* after dental work 🦷; *S. bovis* linked with colorectal carcinoma
Native Valve – Healthcare Associated	*S. aureus*, *Enterococcus* spp., *Staphylococcus epidermidis*	Often related to catheters or invasive procedures
Intravenous	*S. aureus*, Gram-negative rods	Usually involves tricuspid valve;

Drug Users	(*Pseudomonas*), *Candida* spp.	*S. aureus* most common
Prosthetic Valve – Early (<2 months)	*S. epidermidis, S. aureus*	Surgical contamination or biofilm formation ⚙
Prosthetic Valve – Late (>2 months)	*S. aureus, Viridans streptococci, Enterococcus* spp., *S. epidermidis*	Resembles native valve endocarditis
Pacemaker / Defibrillator	*S. epidermidis, S. aureus*	Device-related infection, biofilm on leads
Culture-Negative Endocarditis	Prior antibiotic use, *Bartonella, Coxiella burnetii, Brucella, Tropheryma whipplei*	Often requires serology or PCR for diagnosis

🧠 Mnemonic Tip:

"SHE Can Be Evil" for main categories:

Streptococci → HACEK / Hospital → Enterococcus → Candida → Brucella → Epidermidis (prosthetic/device)

Modified Duke Criteria for the Diagnosis of Infective Endocarditis

✅ Definite Infective Endocarditis

A. Pathologic Criteria

- Microorganism demonstrated by culture or histology in a vegetation, embolized vegetation, or intracardiac abscess

  OR

- Pathologic lesion (vegetation or abscess) confirmed by histology showing active endocarditis

B. Clinical Criteria

Diagnosis is definite when:

- Two major criteria, OR
- One major + three minor criteria, OR
- Five minor criteria

◈ Major Criteria

1. Positive Blood Cultures

    - Typical organism for infective endocarditis isolated from two separate cultures, or
    - Persistently positive cultures, or
    - Single culture or serology positive for *Coxiella*

burnetii

2. Positive Echocardiogram Findings
    - Vegetation, abscess, or new dehiscence of prosthetic valve
3. New Valvular Regurgitation
    - New onset or worsening of existing murmur

◈ Minor Criteria

Minor Criterion	Examples / Explanation
Predisposing condition	Heart disease or IV drug use 💉
Fever	≥38°C
Vascular phenomena	Arterial emboli, septic pulmonary infarcts, Janeway lesions, mycotic aneurysm, intracranial hemorrhage 💧
Immunologic phenomena	Osler's nodes, Roth's spots, glomerulonephritis, positive rheumatoid factor
Microbiologic evidence not meeting major criteria	Single positive culture or atypical organism

Summary Flowchart: Using the Duke Criteria

Clinical suspicion of endocarditis

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Obtain blood cultures + Echocardiogram

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Apply Duke Criteria

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2 Major → Definite IE
1 Major + 3 Minor → Definite IE
5 Minor → Definite IE
1 Major + 1–2 Minor → Possible IE
Fails criteria → Rejected IE