Infective Endocarditis

No.4

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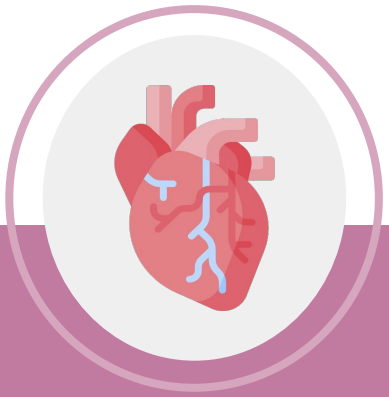

Objectives :

- ★ Understand Infective Endocarditis definition
- ★ Pathophysiology of endocarditis
- ★ Diagnostic criteria of infective endocarditis
- ★ Recognize the risk factors, signs, and symptoms of infectious endocarditis.
- ★ Anticipate possible complications of infective endocarditis
- ★ Treatment of endocarditis and appreciation of the necessity of rapid treatment.
- ★ Endocarditis prophylaxis

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Introduction to IE

What's Infective Endocarditis (IE)? التهاب الشغاف العدوائي

- Infective Endocarditis (one of the diseases called great mimicker) is an **infection of the endocardial surface of the heart**, which may include; one or more heart valves[1](native or prosthetic), Chordae tendineae , a septal defect (e.g. ASD, VSD), AV shunt, Mural endocardium. (IE can extend to all layers of the heart). leading to formation of bulky friable **vegetations** composed of thrombotic debris and organisms. (fibrin, RBCs and inflammatory cells). male Dr442: why the valves? cuz its avascular
- **IE develops most commonly on the mitral valve**, followed by the aortic valve, combined mitral & aortic valve, **tricuspid valve** (especially In IVDU) & rarely, the pulmonic valve.

Epidemiology of IE

- Developing countries (endemic RF), Subacute course, viridans group streptococci.
- Developed countries, acute illness, Staphylococcus aureus (439)(etiology is different from country to country, in north american countries drug abuse is very common, thus IE is usually caused by staph, in saudi the most common cause is streptococcus viridans), with numerous anatomic sites of metastatic foci of infection and worse outcomes.
- Mechanical prosthetic & bioprosthetic valves exhibit equal rates of infection. (439)
- More common in **males** (because of drug abuse)
- It occurs in 5-7 per 100,000 person-years before 2000 and now 15 per 100,000 persons-years[2].
- It remains a life threatening disease with significant mortality (About 20%) and morbidity.

Pathogenesis of IE

- The IE is the net result of the complex interaction between the **bloodstream pathogen** with **matrix molecules and platelets** at sites of **Endocardial cells damage**.

01 — Endothelial damage

Caused by **turbulent blood flow** produced by either a congenital or acquired heart disease (congenital abnormalities of cardiac valves, prosthetic valves). This flow can be from a high to a low pressure chamber[3], High velocity jet or across a narrowed orifice (e.g. Aortic stenosis, Mitral stenosis) which traumatizes the endothelium.

02 — Formation of NBTE

Endothelial damage creates a predisposition for **deposition of platelets and fibrin** on the surface of the endothelium, which results in **Nonbacterial Thrombotic Endocarditis (NBTE)[4].**

03 — Bacterial or fungal adherence

Invasion of the bloodstream(any source) (via mouth, skin or intravenous lines, or gastrointestinal tracts) by a microbial species that has the pathogenic potential to colonize this site (endocardium). This will result in the **proliferation of bacteria within NBTE** (leading to infiltration by neutrophils and macrophages) **forming vegetations[5](hallmark of IE)**

What's the source of the bacteremia in IE?

Trauma to a mucosal surface heavily populated by endogenous microflora; Such as the **gingiva around the teeth and oropharynx** (Old: GI tract, urethra and vagina). This will releases many different microbial species transiently into the bloodstream which will leads to **transient bacteremia**[6] caused by organisms e.g. ***Viridans group streptococci*** .

1-Because its Avascular parts of the heart and its an area where leukocytes doesn't go to.
2- Why is it increased nowadays? Because of the increase in IVDU.
3-Like in Ventricular septal defect; the left side of the heart has higher pressure than the right, so there will be **turbulent blood flow** from Lt to Rt traumatizing the endothelium.
4- AKA Marantic Endocarditis, it's associated with metastatic cancer (Has poor prognosis), It becomes IE when bacterial colonization occurs. Another form of Nonbacterial endocarditis (NBE) is Libman-Sacks Endocarditis, which typically occurs in individuals with SLE. Other causes of NBE include: Cancer of lungs, ovaries.
5- **(1) Local destruction:** Vegetations may destroy the valve itself which may lead to regurgitation, HF etc, It also may form perivalvular abscess if it's in aortic valve (Dangerous and Surgery is required in this case). **(2) Septic embolization**: Vegetations may detach → Septic embolization to any part of the body e.g. Peripherally, spleen, liver, lung, eyes , brain (mycotic aneurysm). Septic embolization may lead to stroke, abscess formation, Gangrene, Hematuria (→ Anemia) and elevated ESR, septic arthritis. Vegetations may also cause**(3) immunological reaction** → Glomerulonephritis, arthritis, Rheumatoid factor, Antinuclear antibody, CRP and ESR.
6-Clinically what symptoms and sign will appear in bacteremia : chills - Rigors - Fever.

Risk factors for IE

Patient factors	Comorbid conditions
• Age: > 60 years(if a 35yo male came with IE, most likely is due to drug abuse, prosthetic valve or congenital heart disease. but if he's 60 and older IE is most likely due to degenerative valve disease) • Gender: Male • **IV drug abuser (IVDU)** (Staph. aureus mainly) • **Poor dentition or dental procedure /infection** (Strep. Viridans mainly)	• Structural heart disease • **Valvular heart disease (VHD**) • Congenital heart disease • **Prosthetic heart valves** / TAVR • **Previous endocarditis** • Intravascular device e.g. indwelling catheters • Cardiac implantable electronic device (pacemakers, ICDs) • Chronic hemodialysis (higher risk of IE due to the frequent use of catheters) • HIV infection

◀ Determining the risk of IE (Usually an exam Q)

442male: 10 حطو عليها
بجماب بيجي بالاجبار

Determining the risk depends on:
1- Presence or absence of cardiac condition. 2- The type of procedure to be done.

High risk[1]
(Need antibiotic prophylaxis)

Antibiotic prophylaxis is reasonable before dental procedures[2] requiring manipulation of gingival or periapical region of teeth or perforation of oral mucosa in patients with the following:

A. Prosthetic cardiac valves including transcatheter valve or prosthetic material used for cardiac valve repair (400x risk , Highest risk)

B. History of previous endocarditis.

C. Congenital heart defect(CHD) such as Ventricular septal defect (VSD), Patent Ductus Arteriosus (PDA) , Coarctation of aorta and Complex cyanotic disease (Tetralogy, Transposition, Single ventricle):

1. Unrepaired cyanotic CHD, including palliative shunts/conduits
2. Any type of CHD (non-cyanotic) repaired with prosthetic material whether placed surgically or by catheter intervention during first 6 months after the procedure or lifelong if residual shunt or valve regurgitation remains
3. Repaired CHD with residual defects at the site or adjacent to the site of a prosthetic patch/prosthetic device that inhibits endothelization

D. Cardiac transplant +(any valvulopathy) with valve regurgitation due to a structurally abnormal valve (develop cardiac valvulopathy).

Antibiotic prophylaxis is no longer recommended for any form of procedure or valvular or congenital heart disease, except for dental procedures that involve manipulation of gingival tissue, periapical region of teeth, Or perforation of oral mucosa and the conditions listed above.

Click here to check the table in females 439 slides

Prophylaxis:

- **For dental procedure at risk** : **Amoxicillin or Ampicillin**:
  - Adults: 2 g orally or IV, single dose **30-60 min before** the procedure.
  - Children: 50 mg/kg orally or IV, single dose **30-60 min before** the procedure.
- **If Allergic to penicillin or ampicillin: Clindamycin**
  - Adults: 600 mg orally or IV, single dose **30-60 min before** the procedure.
  - Children:20 mg/kg orally or IV, single dose **30-60 min before** the procedure.

1-People at high risk should have A very good dental hygiene.
2-Not every dental procedure.
3- **Bacteremia** غالبا **- عشة** لما تفرش أسنانك الصباح وتتحمس وأنت تفرش بعض الأحيان ما تحس بر **فلا تتحمس**

Classification of IE

Nature of the valve involved/ Type of lesion[1]
- Native
- Congenital
- Prosthetic
  - Early
  - Late

Onset and progression
- Acute (Symptoms up to 6wks)
- Subacute (Symptoms up to 6wks-3m)
- Chronic (Symptoms >3 months)

Acquisition of the infection
- Nosocomial
- Community
- IV drug abuse

◀ Acute vs Subacute IE

	Acute	Subacute
Causative organism	**Staphylococcus aureus** (High virulence organism)	**Strept. viridans** or bovis (Low virulence organisms)
Site	Normal heart valves (Most commonly Tricuspid)	Previously damaged heart valves
Prognosis	If untreated, fatal in less than 6 weeks	If untreated, takes much longer than 6 weeks to cause death

◀ Overview on causative organisms

Staph aureus (Including MRSA[2])	• Aggressive acute IE. Metastatic infection, valve destruction. • Mortality 25-40% (left heart)
Coagulase negative Staph e.g. staph epidermidis	• Foreign body infection/prosthesis • Nosocomial infection
☆ **Strep. gallolyticus (previously known as Strep. bovis) And Clostridium Septicum**	• **GI flora associated with polyps and colon cancer** (because the tumor give it access to the bloodstream) , (do Colonoscopy) • Subacute endocarditis, Highly sensitive to penicillin.
Beta-hemolytic strept group A-B-C-G	• Frequent intracardiac & extracardiac complications, abscesses
Enterococci (faecalis, Faecium)	• GI flora, associated with UTI/ nosocomial infection

442male: important

★**What's the most common overall causative agent? Streptococcus viridans** **(Usually an exam Q)**

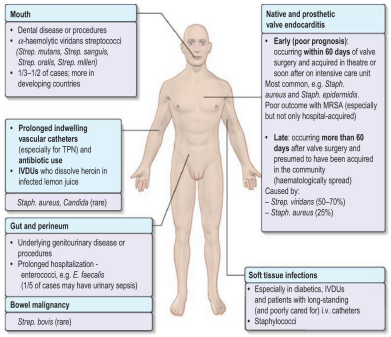
- Patient with history of **VHD** (e.g. Chronic rheumatic heart disease and MVP) and **dental procedure** → ***Streptococcus viridans***
- **IV drug user** presented with endocarditis → ***Staphylococcus aureus***
- Patient who has done **prosthetic valve surgery**, presented with endocarditis later → ***Staphylococcus epidermidis* or aureus** (If within 60d of surgery) or ***Streptococcus viridans*** (If after 60d of surgery)
- Patient has **colorectal cancer** and presented with endocarditis → ***Streptococcus bovis,*** *clostridium septicum*
- Patient presented with endocarditis but all **blood cultures are negative** (cuz they require specific culture)→ ***HACEK*** *(Coxiella and Bartonella)*

1- What carries more risk of IE, native or prosthetic valve? Prosthetic bc it's metal so has no blood supply → no abx can reach it
2- nosocomial infections in recently discharged patients

Microbiology of IE

◀ How to determine the causative agent?

- **It vary depending on the <u>population</u>:**
  1. IV drug abusers
  2. Patients with Prosthetic Heart Valve (PHV)
  3. Hospital acquired vs Community acquired
- **What are the most common causative organisms of IE worldwide?**
  1. **Streptococci:**
     - Common cause of community acquired IE
  2. **Staphylococci:**
     - Most common cause in the US & most developed countries.
     - Health care-associated IE
  3. **Enterococci**



Click here for a few pics present in females 439 slides only

Native valve IE	IV drug abusers IE	Prosthetic valve IE
1. **Streptococci: (50-70%)** a. **Streptococcus viridans (50%)** (in mitral valve prolapse, recent dental extraction) 2. **Staphylococci: (~25%)** a. Mostly Coagulase +ve Staph aureus Or Staph. Epidermidis 3. Enterococci[1] (~10%) 4. HACEK: • **H**aemophilus species, **A**ctinobacillus, **A**ctinomycetemcomitans. **C**ardiobacterium homini **E**ikenella, **K**ingella	○ **Skin is the most predominant source of infection.** ○ **70 - 100% of Right sided IE results in pneumonia and septic emboli.** ○ **It commonly affects tricuspid valve.** ★**Staphylococcus aureus 60%** 2. Streptococci and Enterococci (20%) 3. Gram -ve bacilli (10%) 4. Fungi (Candida and Aspergillus) (5%).	**A) Early onset:** **(< 60d[2] after surgery)** It usually reflects perioperative contamination with Incidence around 1%. 1. **<u>Staph. Epidermidis (30%)</u> or Staph. Aureus (20%).** 2. Gram -ve aerobes (20%) 3. Fungi (10%) 4. Strep and Entero (5-10%) **B) Late onset:** **(>60d[2] after surgery)** Occurs after endothelialization with of Incidence 0.2 -0.5 %، due to transient bacteraemia from dental, GI or GU. 1. **Streptococcus viridans** (resemble native valve IE)

Culture negative endocarditis[3] (Female 439 slides only)

1) **HACEK:** Fastidious gram-negative bacilli, Positive blood culture after 5 days of incubation & maybe longer, large vegetations. (culture -ve species, if you suspect IE but the culture is -ve, you have to think of HACEK) (identification of HACEK is difficult because conventional culture methods produce inconclusive results in cases of fastidious and slow-growing organisms)
2) **Coxiella burnetii (Q fever):**[4] Subacute endocarditis, elevated IgG
3) **Bartonella:** Cat scratch disease
4) **Fungi (candida):** risk factors are immunosuppression, prosthesis, central line, IVDU, invasive endocarditis
5) **Others**: Brucella (history of contact with goats or cattle), tropheryma whipplei, Mycoplasma, legionella

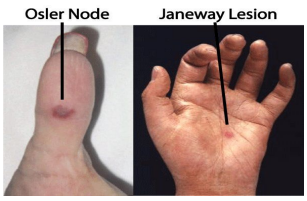
1- e.g. Enterococcus faecalis, and **Strep. gallolyticus (previously known as Strep. bovis),** they enter blood through bowel and Urinary tract. Patients who are found to have **endocarditis caused by Strep. gallolyticus should undergo colonoscopy**, since this organism is associated with colon cancer.
2- In females slides it's 12 months, according to the female Dr, 60 days is the old classification, the new one is 12 months. (In Males slides and Kumar it's 60d)
3- Culture-negative endocarditis usually is caused by prior administration of antibiotics before obtaining blood cultures or by infection with fungi or fastidious organisms.
4- In Q fever endocarditis due to Coxiella burnetii, the patient often has a history of contact with farm animals. The aortic valve is usually affected and there may also be hepatitis, pneumonia and purpura.

Clinical features of IE

◀ Signs & Symptoms

FROM JANE

- **The onset of symptoms is usually within 2 weeks of infection.**



Pictures may come in exam so make sure you know it.

Indolent course

Subacute endocarditis:

- **F**ever, malaise, fatigue, night sweats, anorexia and weight loss. (Constitutional Sx)

Explosive course

Acute endocarditis:

- **Congestive cardiac failure (CCF),** new/changing **m**urmur with severe systemic sepsis.

Other Signs & Symptoms

Immunological features[1,2]

★

- ★ **Osler's Nodes (10-25%): painful (tender)**, red, raised subcutaneous lesions found on the distal hands and feet. (**OUCH**ler nodes to remember it's painful)
- **Roth Spots (5%)**: retinal hemorrhages with white or pale centers[3]. (seen best in slit lamp exam)

- **Glomerulonephritis**
- **+ve Rheumatoid Factor**

Vascular[2] and septic Emboli

★

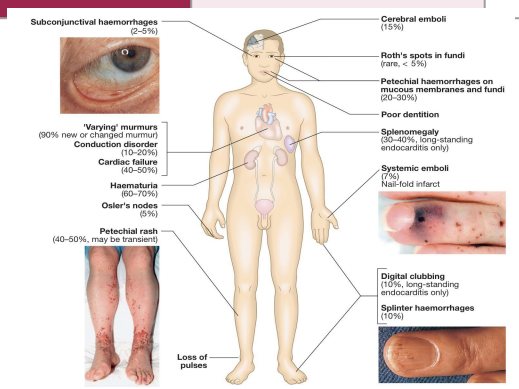
- **Splinter/Nail bed (Or subungual) Haemorrhages**: Dark-red, linear lesions in the nail beds, (5-10%).

- **Septic arthritis**.
- **Janeway Lesion** : **painless (nontender)** hemorrhagic skin lesion in the palm and sole

- **Subconjunctival Hemorrhage**
- **Mycotic Aneurysm**
- **Hematuria** → **A**nemia
- Septic emboli to lung (not a venous thromboembolism)

Other

- **Splenomegaly (30%)**
- **Petechiae[3] (20-40%):** Nonblanching, pinpoint reddish brown macules in conjunctival, buccal mucosa, palate & skin in supraclavicular area.
- Delirium, Pallor, Cardiac arrhythmia, central neurologic abnormalities, Pericardial rub, and Pleural friction rub.



SYMPTOM	PATIENTS AFFECTED (%)
Fever	80-95
Chills	40-70
Weakness	40-50
Malaise	20-40
Sweats	20-40
Anorexia	20-40
Headache	20-40
Dyspnea	20-40
Cough	20-30
Weight loss	20-30
Myalgia/arthralgia	10-30
Stroke	10-20
Confusion/delirium	10-20
Nausea/vomiting	10-20
Edema	5-15
Chest pain	5-15
Abdominal pain	5-15
Hemoptysis	5-10
Back pain	5-10

FINDING	PATIENTS AFFECTED (%)
Fever	80-90
Heart murmur	75-85
New murmur	10-50
Changing murmur	5-20
Central neurologic abnormality	20-40
Splenomegaly	10-40
Petechiae/conjunctival hemorrhage	10-40
Splinter hemorrhages	5-15
Janeway lesions	5-10
Osler nodes	3-10
Retinal lesion or Roth spot	2-10

1- You must differentiate between Immunologic and Septic features.

2- splinter hemorrhage, Janeway lesions, Osler nodes and Roth spots are very specific regions (characteristic of IE) but are rarely seen nowadays due to earlier detection and management of IE. In clinical practice, one might not seen them unless treating a patient from a developing country where healthcare is insufficient. However in olden days patient usually present with subacute course of IE, struggling for months before coming to the hospital thus patient have time to develop these clinical signs.

3- reflects embolization with loss of blood supply surrounded by an area of hemorrhage.

Diagnostic criteria of IE

442male: IMP memorize it

442male: any disease that have criteria for diagnosis means it's hard to diagnose

Duke criteria (Usually an exam Q)

BE FEVER I

Major criteria

1) **Positive blood culture:**
   a) **Typical organism from two separate cultures e.g. Strep, Staph, HACEK**
   b) **Persistent positive blood cultures**
      i) ≥ 2 positive blood cultures of blood samples drawn >12 hrs apart
      ii) All of 3 or a majority of ≥ 4 separate cultures of blood (with 1st and last samples drawn ≥ 1h apart)
   c) **Single positive culture for coxiella burnetii or phase I IgG antibody titre > 1:800**
2) **Endocardial involvement:** (Check definitions next page)
   a) **Positive echocardiographic findings of vegetations,** Abscess , pseudoaneurysm ,intracardiac fistula , valvular perforation, aneurysm or **New partial dehiscence**(unstable/detached)**of prosthetic valve**
   b) **Abnormal activity around the site of prosthetic valve implantation** detected by F-FDG PET/CT (only if the prosthesis was implanted for >3 months) or radiolabeled leukocytes SPECT/CT.
   c) **Definite paravalvular lesion by cardiac CT**
   d) **New valvular regurgitation**

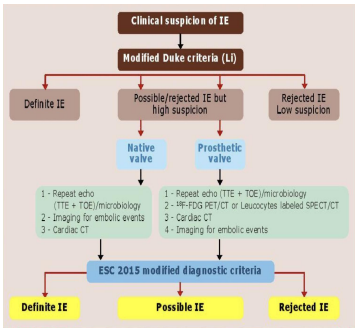
Minor criteria

1) **Fever**: > 38°C
2) **Echo findings**: Any finding not involved in the major criteria e.g. calcification
3) **Vascular phenomena (Including these detected only by imaging):**
   a) Major arterial emboli , septic pulmonary infarcts , infectious (mycotic) aneurysm , intracranial hemorrhage , conjunctival hemorrhage and janeway's lesions.
4) **Evidence from microbiology:**
   a) Positive blood culture but does not meet a major criterion as noted above or serological evidence of active infection with organism consistent with IE.
5) **Risk factors and predisposition:**
   a) Such as heart conditions (e.g. VHD, prosthetic valve, previous IE) or IV drug users
6) **Immunological phenomena:**
   a) Glomerulonephritis , osler's nodes , Roth's spots and Rheumatoid factor

Diagnostic criteria of IE cont'

◄ Duke criteria

- **Definitive IE:** (Begin treatment right away)
  - **Clinical criteria:** Patients with 2 major, **OR** 1 major and 3 minor, **OR** 5 minor.
  - **Pathologic criteria:** Microorganisms or pathologic lesions: demonstrated by culture or histology in a vegetation, or in a vegetation that has embolized, or in an intracardiac abscess
- **Possible IE:** (Requires further tests)
  - **Clinical criteria:** Patients with 1 major and 1 minor, **OR** 3 minor.
  - findings consistent of IE that fall short of "definite", but not "rejected"
- **Rejected IE:**
  - Firm alternate Diagnosis for manifestation of IE
  - Resolution of manifestations of IE, with antibiotic therapy for ≤ 4 days
  - No pathologic evidence of IE at surgery or autopsy, after antibiotic therapy for ≤ 4 days)



◄ Anatomic and echographic definitions

Pathology	Surgery/necropsy	Echocardiography
Vegetation	Infected mass attached to an endocardial structure or an implanted intracardiac material	Oscillating or non-oscillating intracardiac mass on valve or other endocardial structures, or on implanted intracardiac material
Abscess	Perivalvular cavity with necrosis and purulent material not communicating with the cardiovascular lumen	Thickened, non-homogeneous perivalvular area with echodense or echolucent appearance
Pseudoaneurysm	Perivalvular cavity communicating with the cardiovascular lumen	Pulsatile perivalvular echo-free space, with colour doppler flow detected
Perforation	Interruption of endocardial tissue continuity	Interruption of endocardial tissue continuity traversed by colour doppler flow
Fistula	Communication between 2 neighbouring cavities through a perforation	Colour-doppler communication between two neighbouring cavities through a perforation
Valve aneurysm	Saccular outpouching of valvular tissue	Saccular bilging of valvular tissue
Dehiscence of a prosthetic valve	Dehiscence of the prosthesis	Paravalvular regurgitation identified by TEE/TOE, with or without rocking motion of the prosthesis

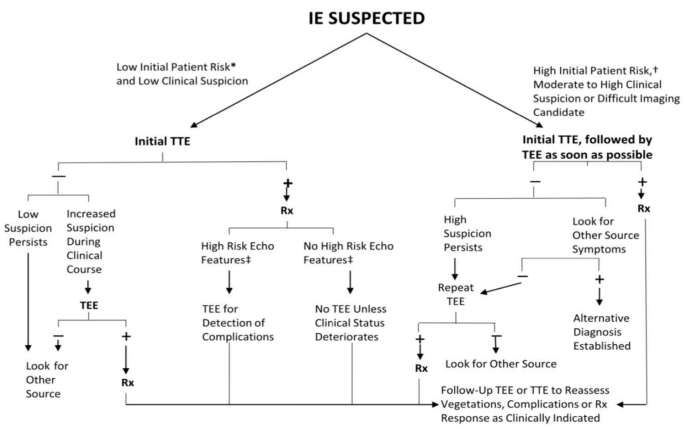
Clinical suspicion & Investigations

◄ Investigations

Investigation	Findings and notes	
Blood cultures	★ **It's the key diagnostic investigation (Best initial)** • At least 3 sets of samples taken from different venipuncture sites[1] over 24h under a meticulous aseptic technique.	
Serological tests	Consider in culture-negative cases for Coxiella, Bartonella, Legionella, Chlamydia	
CBC	Reduced haemoglobin (anemia), increased white cells, increased or reduced platelets	
Inflammatory markers	Increased erythrocyte sedimentation rate ESR and C-reactive protein (CRP reduces in response to therapy and increases with relapse, making it helpful in monitoring therapy)	
RFT	Increased urea and creatinine due to glomerulonephritis	
Urine	Proteinuria and haematuria (Could be due to glomerulonephritis or sepsis)	
ECG	PR prolongation/heart block is associated with aortic root abscess	
CXR	Pulmonary oedema in left-sided disease, pulmonary emboli/abscess in right-sided disease	
Echo (Cornerstone of diagnosis)	**Transthoracic echocardiography[2] (TTE)**	**First-line non-invasive imaging test** with sensitivity of 70%; demonstrates **vegetations**, valvular dysfunction, ventricular function, abscesses
	Transesophageal echocardiography[3] (TEE/TOE)	**Second-line invasive imaging** test with **greater sensitivity (96%) and specificity;** useful in suspected aortic root abscess and essential in prosthetic valve endocarditis, intracardiac devices or complications

Diagnosis of IE:

- Diagnosis of IE depends on **clinical suspicion[4], blood culture, Echocardiography**
- **When IE is suspected the best initial test is to obtain serial blood cultures.**
- Patients with suspected IE should have appropriate blood cultures drawn **prior to cardiac imaging studies. (TTE should be attempted first in most cases. TEE should be used if TTE is nondiagnostic)**



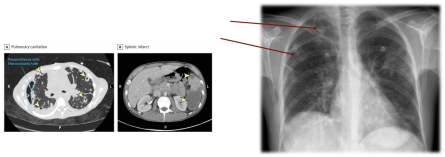
1- to ensure it is an infection and not just a contaminated sample.
2- normal echo(TTE) cannot rule the diagnosis out because the vegetation can migrate , so maybe the pt had vegetation but it migrated to the brain or the abdomen
3- Only negative findings on (TEE) can reliably rule out endocarditis, as (TTE) is not sensitive enough!
4- By checking the patient history e.g. if the patient underwent a dental procedure in the last 4wks or if the patient has any cardiac lesions (e.g. Prosthetic valve) then you must have high clinical suspicion of IE.

Complications of IE

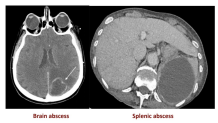
◀ Complications of IE

<table>
<tr><td rowspan="2">Embolic</td><td>Risk factors for embolic (Females 439 slides only)</td><td>

Size of vegetation (>10 mm)
Left side vegetations
Staph. Aureus
Fungal pathogens

Uncommon after 2 weeks of effective treatment

Septic Emboli
</td></tr>
<tr><td>Complications</td><td>

Neurological manifestations (⅓ of cases): caused by stroke either due to major embolism to MCA (25%) or ICH from a ruptured mycotic aneurysm (2-10%) or hemorrhagic transformation of stroke.
MI, PE (Septic emboli “Pulmonary cavitation”)
Ischemic limb, Mesenteric ischemia
Splenic or renal infarction
Digital infarcts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<tr><td colspan="2">Local spread</td><td>

Congestive Heart failure (The commonest complication): Caused by extensive valvular destruction, ruptured chordae tendineae, fistulas, valve obstruction, Myocarditis, Coronary artery embolism and MI, Myocardial Abscesses.
Paravalvular abscess: Most common in aortic valve[1] , IVDA, staph, aureus
AV block / conduction disorders: Myocardial abscesses
Pericarditis

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<tr><td colspan="2">Metastatic spread</td><td>

Rt. Sided vegetations: Lung abscesses, Pyothorax / Pyo-pneumothorax
Lt. Sided vegetations: Pyogenic Meningitis, Splenic Abscesses, Pyelonephritis, Osteomyelitis
Metastatic abscesses
Septic arthritis

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<tr><td colspan="2">Formation of immune complexes</td><td>

Immune complex glomerulonephritis leading to Acute renal failure
Immunologic arthritis

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Why would fever persist for a long time? (Females 439 slides only)

Resolution of fever occurs in 5-7 days; persistence of fever indicates:

- Abscess
- Infected indwelling catheters or devices
- Septic embolization
- An extracardiac site of infection (native or prosthetic)
- Inadequate antibiotic treatment of resistant organism
- An adverse reaction to the antibiotic therapy itself (uncommon)

1- monitored by an ECG “prolonged PR interval due to the close proximity between AV node and root of aortic valve”

Management of IE

◀ Medical therapy (Antibiotics)[1]

Click here for a few treatment tables present in females slides only

★ Empirical therapy:

Empirical treatment depends on the **mode of presentation**, the **suspected organism** and the **presence of a prosthetic valve** or penicillin allergy.

Acute onset	Subacute onset[2]	Prosthetic valve IE
Blood culture and start treatment within 3 hours. **Abx:** Vancomycin and Gentamicin	Blood culture then antibiotic can be started within 3 days. **Abx:** Amoxicillin with/without gentamicin	**Abx:** Vancomycin, gentamicin and rifampicin

- ### After identification of the causal organism:

Principles of medical therapy: Treat vegetations with with high dose of IV bactericidal abx for prolonged duration (**Generally native valve → 2-4wks and Prosthetic valve → 6-8wks**.)

Staphylococcus	Strep. viridans or bovis
Native valve • **MSSA: Flucloxacillin *OR* Naficillin *OR* Oxacillin** for 4wks • **MRSA & Penicillin allergic Pts: Vancomycin** for 4-6wks **Prosthetic valve** (may need longer treatment durations) • **MSSA: Flucloxacillin *with* gentamicin and rifampicin** • **MRSA & Penicillin allergic Pts: Vancomycin, *with* gentamicin and rifampicin**	**Penicillin susceptible:** • **IV Ceftriaxone** once daily for 4 weeks (cure rate >98%) • ***OR* Ceftriaxone** 2g once daily for 2 weeks ***followed*** by **oral amoxicillin** qid (four times a day) for 2 weeks • ***OR* IV penicillin G *OR* IV amoxicillin** for 4 weeks • In B-lactam allergic patients: **Vancomycin**. **Penicillin resistant:** • **Ceftriaxone *with* Gentamicin *OR* Penicillin G *OR* Amoxicillin**. • In B-lactam allergic patients: **Vancomycin *with* Gentamicin**

Enterococci: Ampicillin and gentamicin **& for HACEK group** use Ceftriaxone

Feel lost? click here

◀ Surgical therapy

- **Indications for cardiac surgery in IE:**
  - **A. Heart failure due to valve damage** e.g. Dehiscence, intracardiac fistula or prosthetic dysfunction
  - B. Failure of abx therapy: persistent infection (bacteremia or fever) lasting >5-7 days after starting abx
  - **C. Large/persistent vegetations** on left-sided heart valves with echo appearance suggesting high risk of **recurrent emboli**.
  - D. IE complicated by heart block, annular abscess, or destructive perforating lesions.
  - E. Patients with **fungal endocarditis** often require cardiac surgery.
  - F. Prosthetic valve IE caused by fungi or highly resistant organisms. (Female 439)

1-Exam Q : What is the main state for treatment = Antibiotics. (usually you start broad then you narrow down based on the culture).
2- If the presentation is subacute, antibiotic treatment should **ideally be withheld until the results of blood cultures are available**. However, if empirical antibiotic treatment is considered necessary give the ones mentioned.

Prevention of IE

◀ Prevention

- **Main principles of prevention:**
  - The principle of antibiotic prophylaxis when performing procedures at risk of IE in patients with predisposing cardiac conditions is maintained.
  - Antibiotic prophylaxis must be limited to patients with highest risk of IE undergoing the highest risk dental procedures.
  - Good oral hygiene and regular dental review are more important than antibiotic prophylaxis
  - Aseptic measures are mandatory during venous catheter manipulation and during any invasive procedures in order to reduce the rate of healthcare-associated IE.
  - Whether the use of antibiotic prophylaxis is really associated with a change is the incidence of IE needs further investigations.

Clinical case

Extra

A 77-year-old man is brought to the emergency department by his daughter after he developed weakness in his right upper extremity. She says that he has been sick for the past two weeks with fever, chills, and night sweats and that he has lost nearly 4.5 kg (10 lb) during that time. He had attributed these symptoms to the flu, but he could not move his left arm when he woke this morning. He denies other symptoms. On further questioning, his general health is good except for poorly controlled hypertension, and he underwent an aortic valve replacement 2 months ago. Physical examination is remarkable for upper left hemiplegia, the click of his prosthetic valve, and the image below on fundoscopic exam. Vital signs include a temperature of 38.9°C (102.0 °F), blood pressure of 114/55 mm Hg, and pulse of 115/min.

Q1: What's the most likely diagnosis?

Given the patient's history and physical findings, the most likely diagnosis is infective endocarditis (IE)

Q2: What tests and/or imaging tools could be used to confirm the diagnosis?

This diagnosis should be made by:

- Three **blood cultures** separated by at least 1 hour from different venipuncture sites.
- **Echocardiography** should be done in all patients with moderate suspicion of IE.
  - TTE should be attempted first in most cases. TEE should be used if TTE is nondiagnostic.
- **ECG** baseline should be obtained.
- Antibiotic treatment is organism specific and usually lasts 4–6 weeks for native valves and at least 6 weeks for prosthetic valves.

Q3: What are the Duke criteria?

BE FEVER I

Summary

Infective endocarditis

Definition	An infection of the endocardial surface of the heart, which may include; one or more heart valves (native or prosthetic), the mural endocardium	
Pathophysiology	Endothelial damage → NBTE formation → Bacterial adherence → Formation of vegetations (Hallmark of IE)	
Risk factors	Poor dentition, Cardiac issues (e.g. Congenital heart disease, VHD , prosthetic valve), IVDU.	
Onset	**Acute**	**Subacute**
	• **Causative organism:** Staph. aureus • **Site:** Normal valves • **Prognosis:** If untreated, fatal in < 6 weeks	• **Causative organism:** Strep. viridans • **Site:** Previously damaged valves • **Prognosis:** If untreated, takes > 6 weeks to cause death
Microbiology of IE	What's the most common overall causative agent? **Streptococcus viridans** • Patient with history of **VHD** (e.g. Chronic rheumatic heart disease and MVP) and **dental procedure** → ***Streptococcus viridans*** • **IV drug user** presented with endocarditis → ***Staphylococcus aureus*** • Patient who has done **prosthetic valve surgery**, presented with endocarditis later → ***Staphylococcus epidermidis or aureus*** (If within 60d of surgery) or ***Streptococcus viridans*** (If after 60d of surgery) • Patient has **colorectal cancer** and presented with endocarditis → ***Streptococcus bovis*** • Patient presented with endocarditis but all **blood cultures are negative** → ***HACEK*** (*Haemophilus, Actinobacillus, Cardiobacterium, Eikenella, Kingella*)	
S & S	**FROM JANE**	
Duke criteria	**BE FEVER I** **Definitive IE:** Clinical criteria: Patients with 2 major, or 1 major and 3 minor, or 5 minor **Possible IE:** Clinical criteria: Patients with 1 major and 1 minor, or 3 minor	
Investigations	• **Blood cultures** • **Echocardiography:** TTE should be attempted first. TEE should be used if TTE is nondiagnostic • Others: ECG, CBC, RFT, Inflammatory markers, CXR	
Complications	Focal neurologic deficits from embolic **strokes**, **splenic abscess**, **Congestive heart failure** caused by valvular insufficiency, and **glomerulonephritis**.	

Treatment

Staphylococcus	Strep. viridans or bovis
Native valve • **MSSA: Flucloxacillin** • **MRSA & Penicillin allergic Pts: Vancomycin** **Prosthetic valve** • **MSSA: Flucloxacillin *with* gentamicin and rifampicin** • **MRSA & Penicillin allergic Pts: Vancomycin, *with* gentamicin and rifampicin**	**Penicillin susceptible:** • **IV Ceftriaxone** once daily (third generation cephalosporin) ***OR*** **IV penicillin G *OR* IV amoxicillin** for 4 weeks ; ***OR*** **Ceftriaxone** 2g for 2 weeks ***followed*** by **oral amoxicillin** for 2 weeks. • In B-lactam allergic patients: **Vancomycin**. **Penicillin resistant:** • **Ceftriaxone *with* Gentamicin *OR* Penicillin G *OR* Amoxicillin**. • In B-lactam allergic patients: **Vancomycin *with* Gentamicin**

EXTRA

Helpful figures

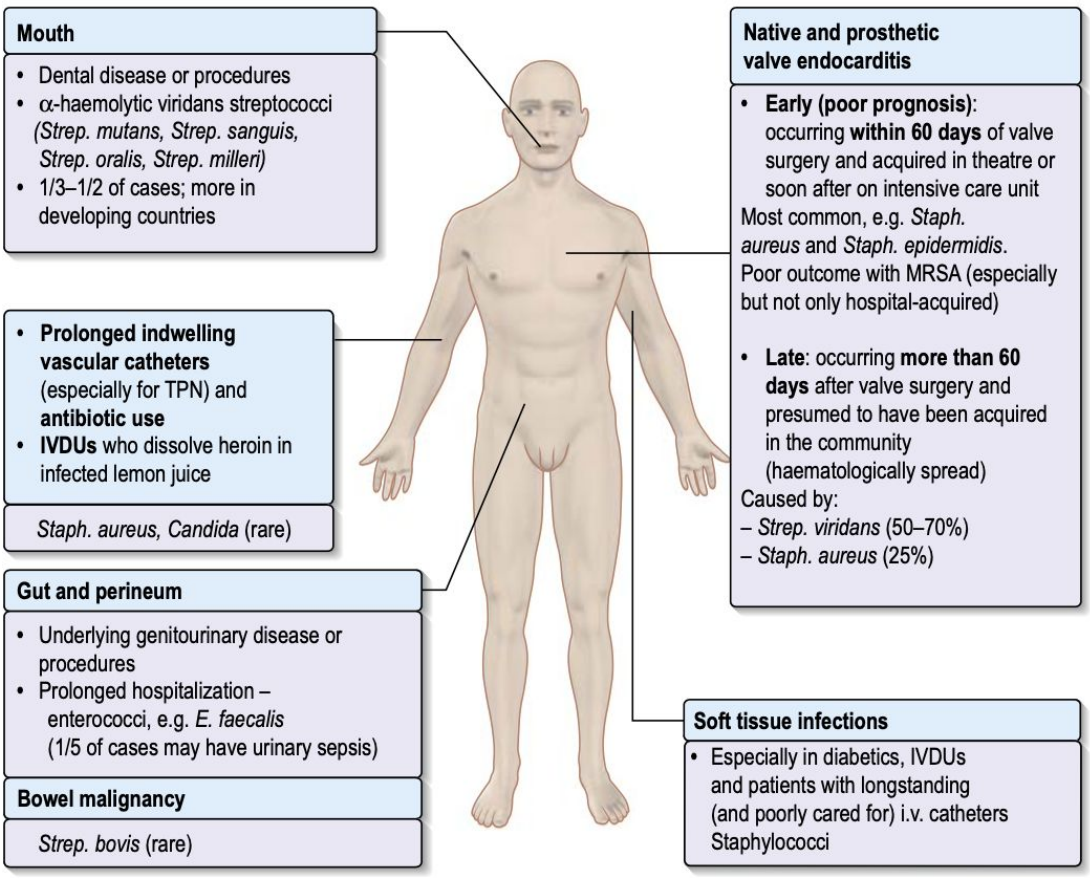

Fig. 30.89 Infective endocarditis: aetiology and sources of infection. IVDU, intravenous drug user; MRSA, meticillin-resistant *Staphylococcus aureus*; TPN, total parenteral nutrition.

i Box 30.46 Clinical features of infective endocarditis

Clinical feature	Approximate %
General	
Malaise	95
Clubbing	10
Cardiac	
Murmurs	90
Cardiac failure	50
Arthralgia	25
Pyrexia	90
Skin lesions	
Osler nodes	15
Splinter haemorrhages	10
Janeway lesions	5
Petechiae	50
Eyes	
Roth spots	5
Conjunctival splinter haemorrhages	Rare
Splenomegaly	40
Neurological	
Cerebral emboli	20
Mycotic aneurysm	10
Renal	
Haematuria	70

i Box 30.47 Investigations and findings in endocarditis

Investigation	Findings and notes
Blood cultures	Three sets from different venepuncture sites
Serological tests	Consider in culture-negative cases for *Coxiella*, *Bartonella*, *Legionella*, *Chlamydia*
Full blood count	Reduced haemoglobin, increased white cells, increased or reduced platelets
Serum creatinine and electrolytes	Increased urea and creatinine
Liver biochemistry	Increased serum alkaline phosphatase
Inflammatory markers	Increased erythrocyte sedimentation rate and C-reactive protein (CRP reduces in response to therapy and increases with relapse)
Urine	Proteinuria and haematuria
Electrocardiogram	PR prolongation/heart block is associated with aortic root abscess
Chest X-ray	Pulmonary oedema in left-sided disease, pulmonary emboli/abscess in right-sided disease
Transthoracic echocardiography	First-line non-invasive imaging test with sensitivity of 60–75%; demonstrates vegetations, valvular dysfunction, ventricular function, abscesses
Transoesophageal echocardiography	Second-line invasive imaging test with greater sensitivity (>90%) and specificity; useful in suspected aortic root abscess and essential in prosthetic valve endocarditis

Lecture Quiz

Q1: A 68-year-old man is hospitalized with Streptococcus bovis endocarditis of the mitral valve and recovers completely with appropriate therapy. Which of the following is the most important next step?

A- Good dental hygiene and proper denture fitting to prevent reinfection of damaged heart valves from oral flora.
B- Repeat echocardiography in 6 weeks to ensure the vegetations have resolved.
C- Colonoscopy to look for mucosal lesions.
D- Mitral valve replacement to prevent systemic emboli such as cerebral infarction.

Q2: A 24-year-old intravenous drug user is admitted with 4 weeks of fever. He has three blood cultures positive with Candida spp and suddenly develops a cold blue toe. Which of the following is the appropriate next step?

A- Repeat echocardiography to see if the large aortic vegetation previously seen has now embolized.
B- Cardiovascular surgery consultation for aortic valve replacement.
C- Aortic angiography to evaluate for a mycotic aneurysm, which may be embolizing.
D- Switch from fluconazole to amphotericin B.

Q3: A 25-year-old woman presents to the emergency department with fever and back pain. he patient has been using intravenous heroin for the past few years; she had one prior episode of soft tissue abscess after injection but no other illnesses in the past. She now complains of 2 weeks of fevers, sweats, muscle aches, and some low back pain. On examination she is tachycardic, diaphoretic, febrile (102°F), and ill appearing. Cardiac examination reveals a new systolic murmur. Blood is drawn for basic laboratory findings and blood cultures (two sets). Given her ill appearance, the admitting physician decides to start empiric antibiotics for the most likely pathogens immediately. The best empiric antibiotic regimen for this patient is:

A- Vancomycin + Gentamicin
B- Vancomycin + gentamicin + rifampin
C- Vancomycin + caspofungin
D- Ampicillin + gentamicin

Q4: A 32-year-old woman presents with fever. She has a salient medical history of intravenous drug abuse. On examination, her temperature is 102°F. She has a grade 2 of 6 diastolic blowing murmur at the base. here are splinter hemorrhages in the nails. Blood cultures grow methicillin-sensitive Staphylococcus aureus (MSSA). An electrocardiogram reveals normal sinus rhythm. A transthoracic echocardiogram reveals moderate aortic regurgitation and an 8-mm vegetation on the aortic valve. She is hospitalized for evaluation and treatment and is initiated on nafcillin. On hospital day 3, her fevers persist. An electrocardiogram demonstrates a prolonged PR interval with periods of Mobitz II AV block. What is the next step in diagnosis?

A- Electrophysiologic testing
B- Brain MRI
C- Transesophageal echocardiogram
D- Request blood cultures to be incubated for 14 days.

Q5: A 90-year-old man presents to accident and emergency with a 2-week history of fevers, lethargy and night sweats. He has recently had crowns fitted at the dentists. He has a past medical history of hypertension, gout and type 2 diabetes mellitus. On examination his temperature is 39°C, his pulse is 120bpm and splinter haemorrhages are seen in the nails. On auscultation of the heart a pansystolic murmur is audible. A diagnosis of endocarditis is suspected and blood cultures are taken. What organism is most likely to be grown?

A- Staphylococcus aureus
B- Actinobacillus
C- Enterococcus faecalis
D- Streptococcus viridans

Answers: Q1:C | Q2:B | Q3:A | Q4:C | Q5:D

Answers Explanation File!

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