

The background features a semi-transparent anatomical illustration of a human heart and hand. The heart is shown in a cross-section, revealing internal structures like the ventricles and valves. A hand is positioned as if holding the heart. The overall color palette is soft, with pinks, purples, and whites.

INFECTIVE ENDOCARDITIS

By

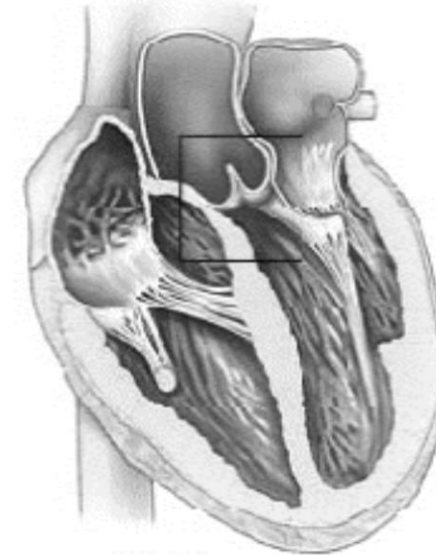
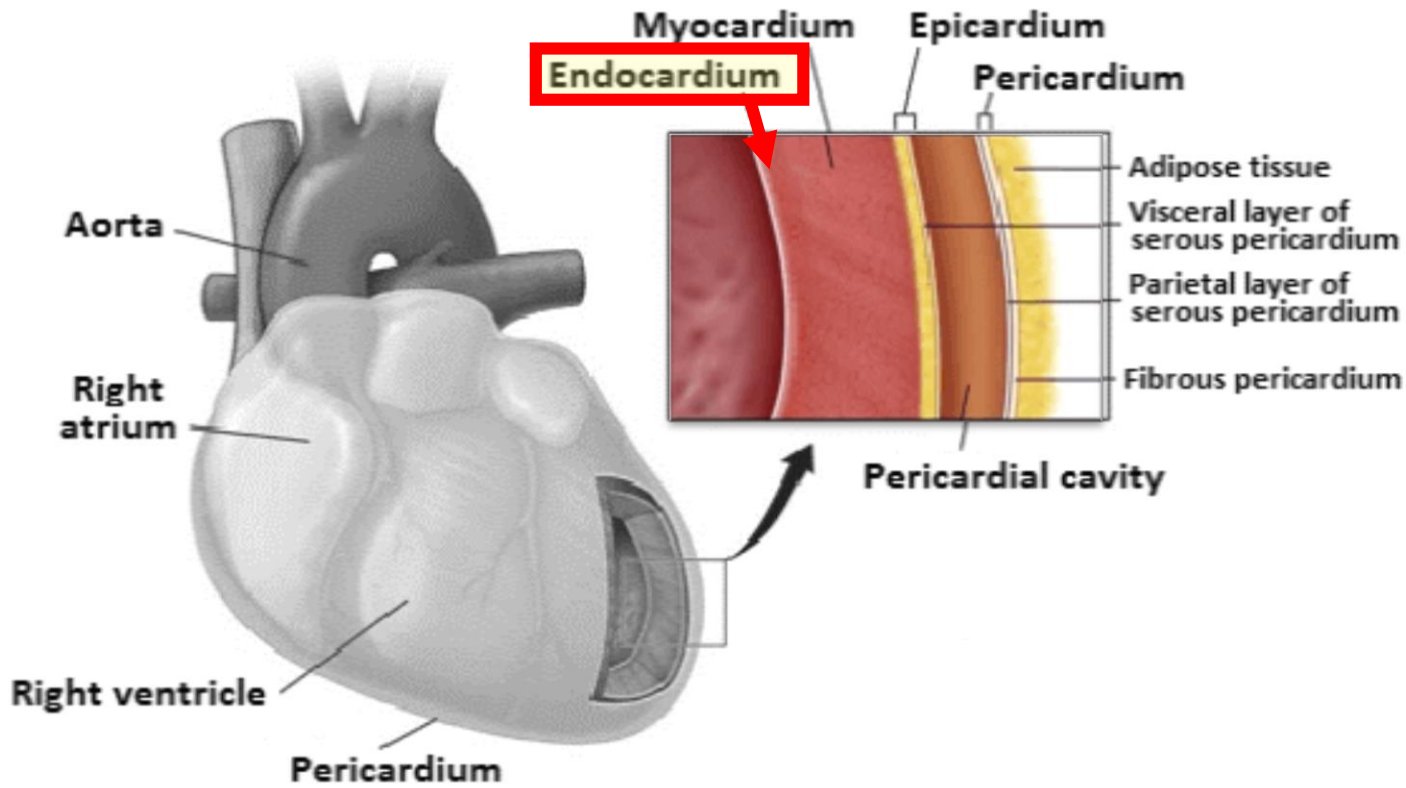
**Dr. Sheerwan Bahaa Assim
Interventional Cardiologist**



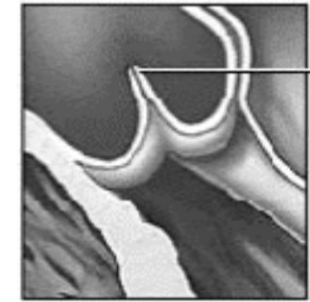
Objectives

- Definition
- Pathophysiology
- Microbiology
- Clinical features
- Investigations
- Treatment
- Prophylaxis

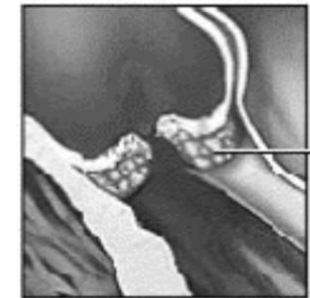
Endocarditis



Cross section of the heart



Normal aortic valve

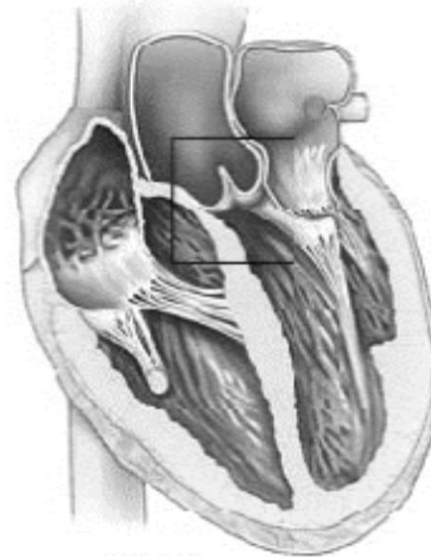
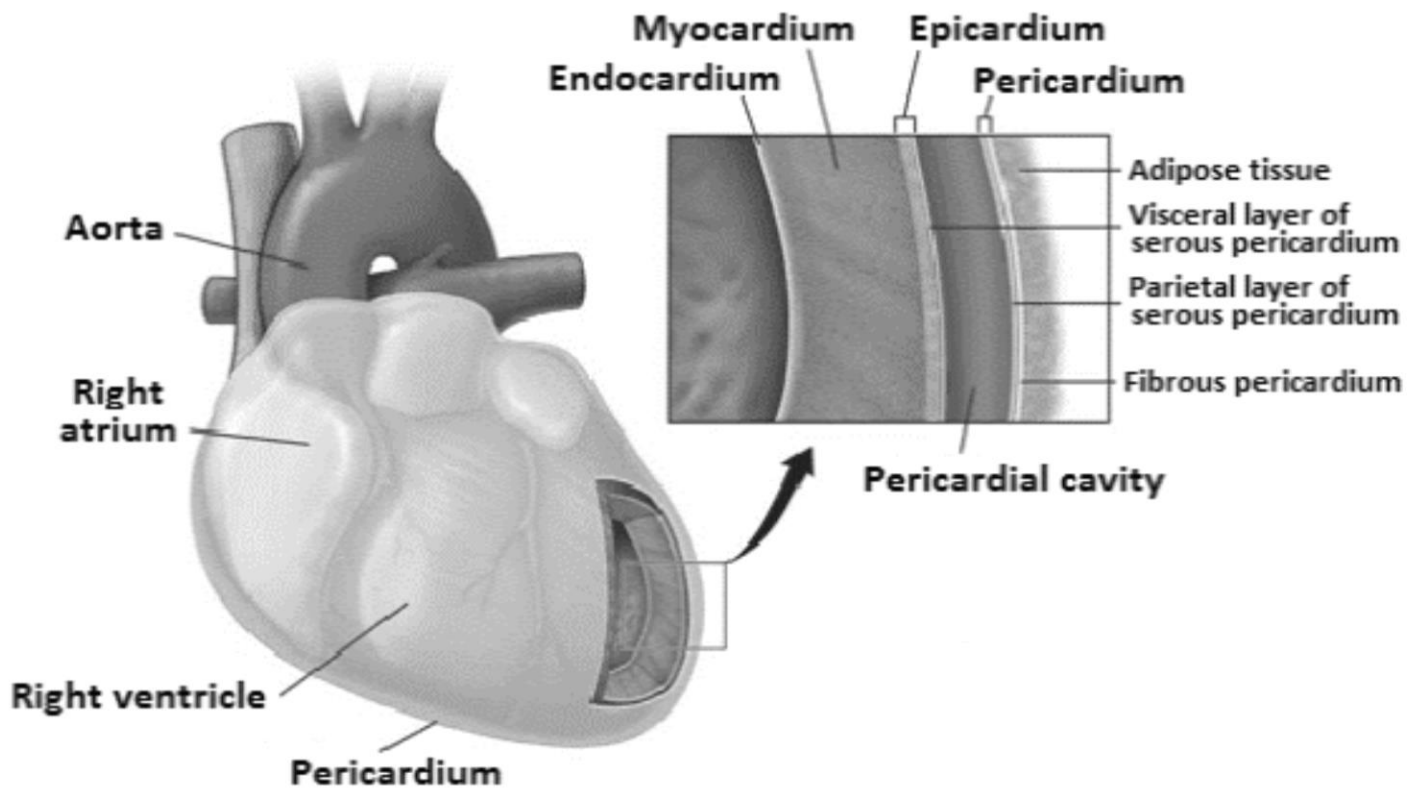


Area of infection on aortic valve

What is the endocardium?

The heart's endocardium is the innermost layer of tissue that lines the chambers of the heart. It covers the [left atrium](#), the [right atrium](#), the [left ventricle](#), and the [right ventricle](#). In addition, it covers and forms the surface of the four heart valves.

Endocarditis



Cross section of the heart



Normal aortic valve



Area of infection on aortic valve

Infective endocarditis

Microbial infection of endocardium of any of the following:

- A heart valve (native or prosthetic valves)
- The lining of a cardiac chamber
- The lining of a blood vessel
- Congenital heart defects

Fatality is approximately **20% even with treatment**

Pathophysiology

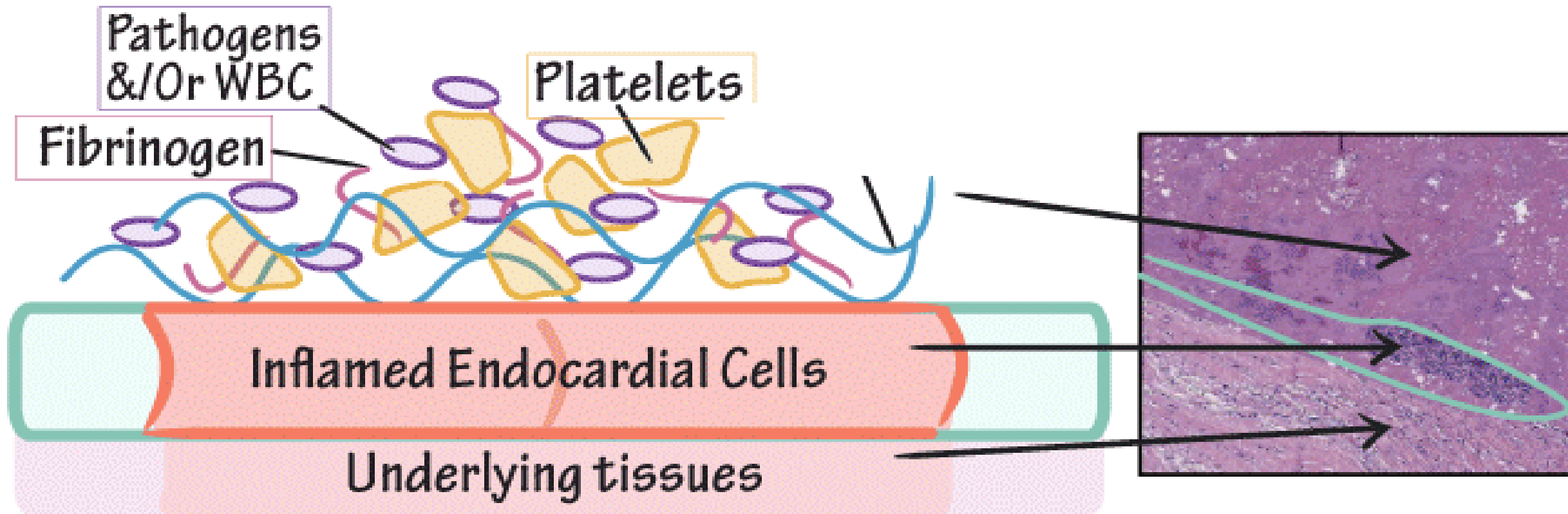
➤ **Abnormal heart (sites of pre-existing endocardial damage) :**

The most vulnerable areas of endocardial damage that are caused by a **high-pressure jet** of blood, such as VSD, AR ,MR.

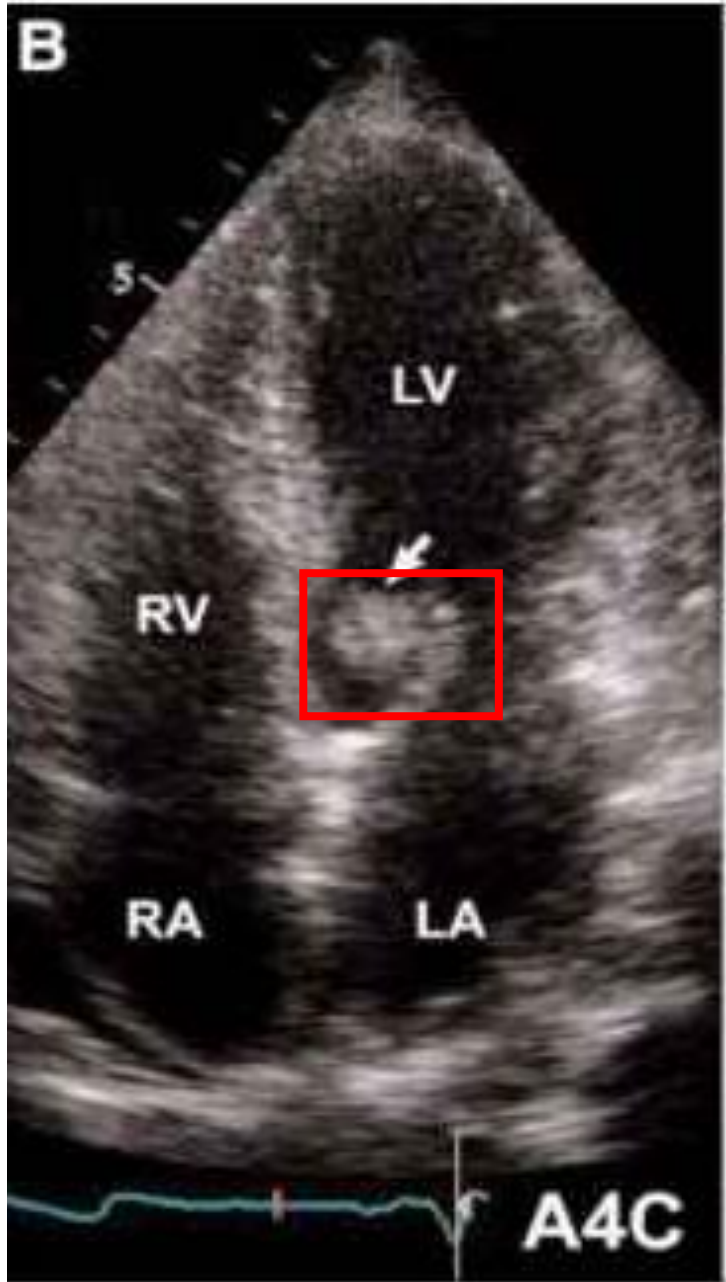
The risk is minimal at **low pressure lesions**, such as a large ASD

➤ **Normal heart :** infection with particularly virulent or aggressive organisms such as ***Staphylococcus aureus*** can cause endocarditis in a previously normal heart.

Vegetations



The avascular valve tissue and presence of fibrin and platelet aggregates help to **protect proliferating organisms** from host defence mechanisms.



LV : left ventricle

LA : left atrium

RV : right ventricle

RA : right atrium

➤ Cardiac manifestation :

Vegetations can :

- Become Large → **Severe obstruction** (uncommon; most with fungal infective endocarditis)
- Damage the valve by (tissue distortion, cusp perforation or disruption of chordae) → **severe regurgitation** → heart failure
- Destroy adjacent tissues → **abscess** formation

➤ **Extra-cardiac manifestations :**

- **Immune phenomenon :**

Vasculitis , glomerulonephritis

- **Embolic phenomenon :**

Brain (CVA) , limb (acute limb ischemia), kidney (AKI), spleen (Acute splenic infarction)

Mycotic aneurysms may develop in arteries at the site of infected emboli (e.g cerebral mycotic aneurysm)

Microbiology

Over three-quarters of cases are caused by **streptococci or staphylococci**.

1- **Staph. aureus**

- **The most common cause of IE**
- **Highly virulent and invasive**, usually producing florid vegetations, rapid valve destruction and abscess formation.
- **Origin** : skin infections, abscesses or vascular access sites (IV or central lines) or from IV drug use.

2- **Viridans streptococci**

(such as Strep. mitis and Strep. sanguis)

- **Oral cavity commensals**
- **Origin**: chewing or tooth-brushing, or at the time of dental treatment

3- HACEK group (3-4%)

(Haemophilus aphrophilus , Aggregatibacter actinomycetemcomitans; Cardiobacterium hominis; Eikenella corrodens; and Kingella kingae)

- **Oropharyngeal commensals**
- **Origin** : poor dental hygiene and recent dental procedures
- Prolonged culture is required The diagnosis may be revealed only after

4- Coagulase-negative staphylococci (CONS)

1. Staph. Epidermidis

2. *Staph.lugdenensis*:(rapidly destructive and associated with multiple emboli)

- They are part of the **normal skin flora**.
- **Origin** : Post-operative endocarditis after cardiac surgery.

They cause native valve endocarditis in approximately 5% of cases and

Should not be routinely dismissed as blood culture contaminants.

5- Enterococcus faecalis, Enterococcus faecium and Strep. gallolyticus (previously known as Strep. bovis)

- **Origin:** bowel or urinary tract.
- Strep. gallolyticus associated with large bowel malignancy

6- Q fever endocarditis (*Coxiella burnetii*)

- **Origin** : farm animals(cattle , sheep, goats : urine, feces , milk)
- The aortic valve is usually affected and there may also be hepatitis, pneumonia and purpura. Life-long antibiotic therapy may be required.

7- *Brucella endocarditis*

Origin: contact with goats or cattle.

8- Yeasts and fungi

- **Origin:** immunocompromised patients or those with in-dwelling intravenous catheters.
- Abscesses and emboli are common, **mortality is high.**
- Therapy is difficult, **surgery** is often required

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16.94 Microbiology of infective endocarditis

| Pathogen | Of native valve (n = 280) | In injection drug users (n = 87) | Of prosthetic valve | |
|-------------------------------|------------------------------|-------------------------------------|---------------------|------------------|
| | | | Early (n = 15) | Late (n = 72) |
| Staphylococci | 124 (44%) | 60 (69%) | 10 (67%) | 33 (46%) |
| <i>Staph. aureus</i> | 106 (38%) | 60 (69%) | 3 (20%) | 15 (21%) |
| Coagulase-negative | 18 (6%) | 0 | 7 (47%) | 18 (25%) |
| Streptococci | 86 (31%) | 7 (8%) | 0 | 25 (35%) |
| Oral | 59 (21%) | 3 (3%) | 0 | 19 (26%) |
| Others (non-enterococcal) | 27 (10%) | 4 (5%) | 0 | 6 (8%) |
| Enterococcus spp. | 21 (8%) | 2 (2%) | 1 (7%) | 5 (7%) |
| HACEK | 12 (4%) | 0 | 0 | 1 (1%) |
| Polymicrobial | 6 (2%) | 8 (9%) | 0 | 1 (1%) |
| Other bacteria | 12 (4%) | 4 (5%) | 0 | 2 (3%) |
| Fungi | 3 (1%) | 2 (2%) | 0 | 0 |
| Negative blood culture | 16 (6%) | 4 (5%) | 4 (27%) | 5 (7%) |

(HACEK = *Haemophilus aphrophilus* – now known as *Aggregatibacter aphrophilus*–*Aggregatibacter actinomycetemcomitans*; *Cardiobacterium hominis*; *Eikenella corrodens*; and *Kingella kingae*)

Adapted from Moreillon P, Que YA. Infective endocarditis. *Lancet* 2004; 363:139–149.

Clinical features

- Acute
- Subacute

There is considerable overlap because :

1- The clinical pattern is influenced by the

- Microorganism
- Site of infection
- Prior antibiotic therapy
- Presence of a valve or shunt prosthesis

2-The subacute form may abruptly develop acute life-threatening complications, such as valve disruption or emboli.

IE should be suspected when a patient with congenital or valvular heart disease develops

- Persistent fever, unusual tiredness, night sweats or weight loss (**constitutional symptoms**)
- New signs of valve dysfunction or **heart failure**.
- Less often the patient can present with complications:

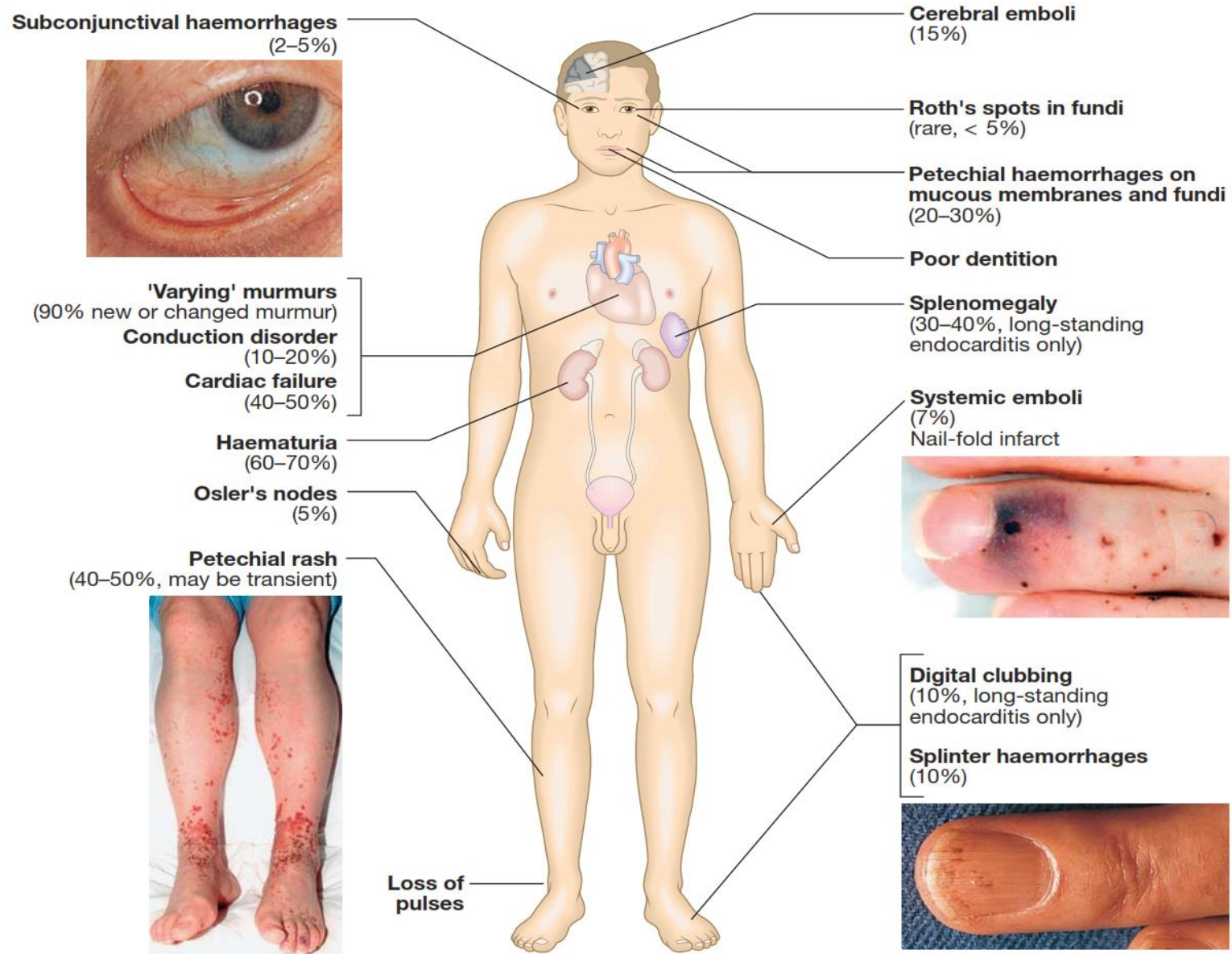


Fig. 16.89 Clinical features that may be present in endocarditis. Insets (Petechial rash, nail-fold infarct). From Newby D, Grubb N. *Cardiology: an*

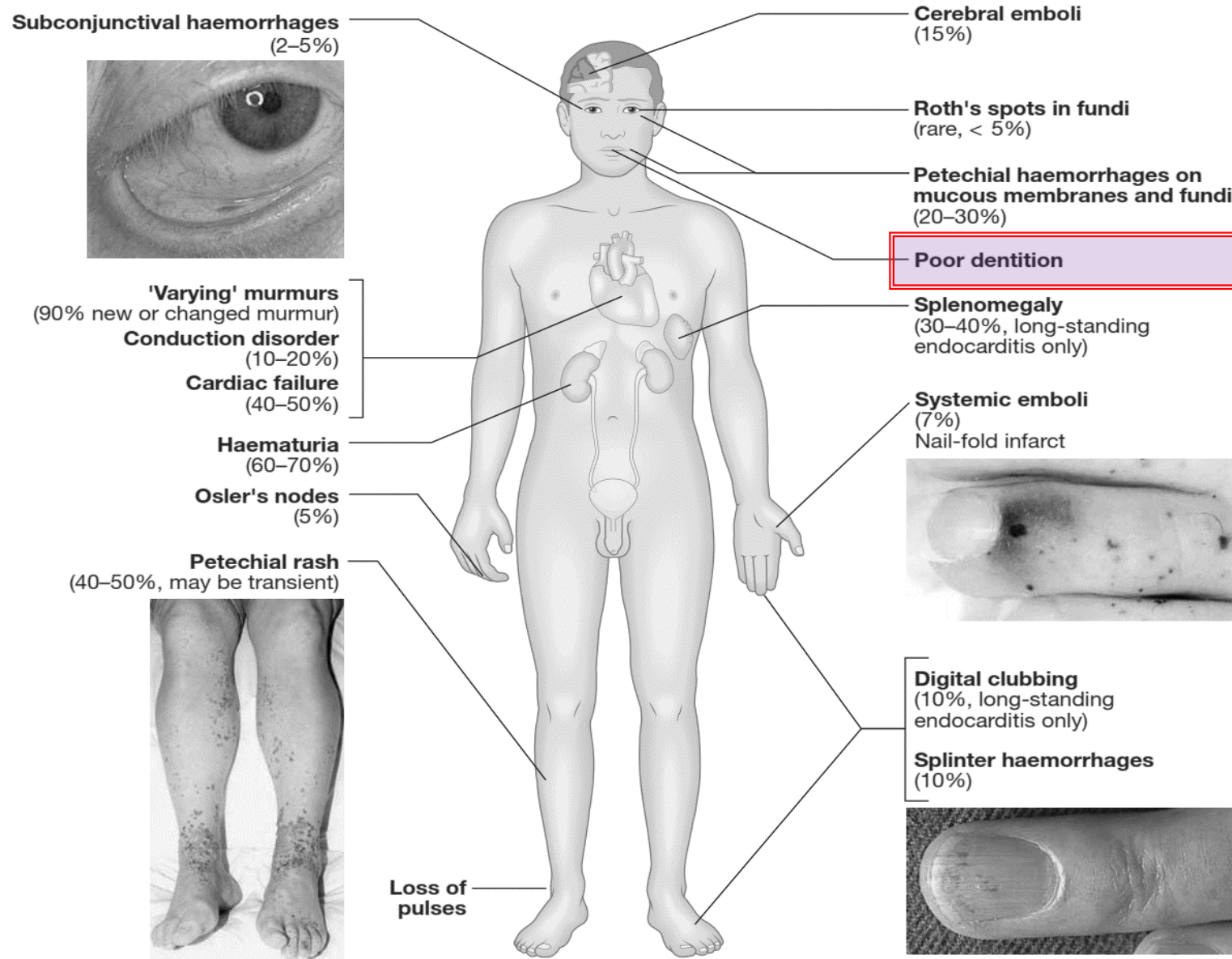


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Embolitic phenomenon

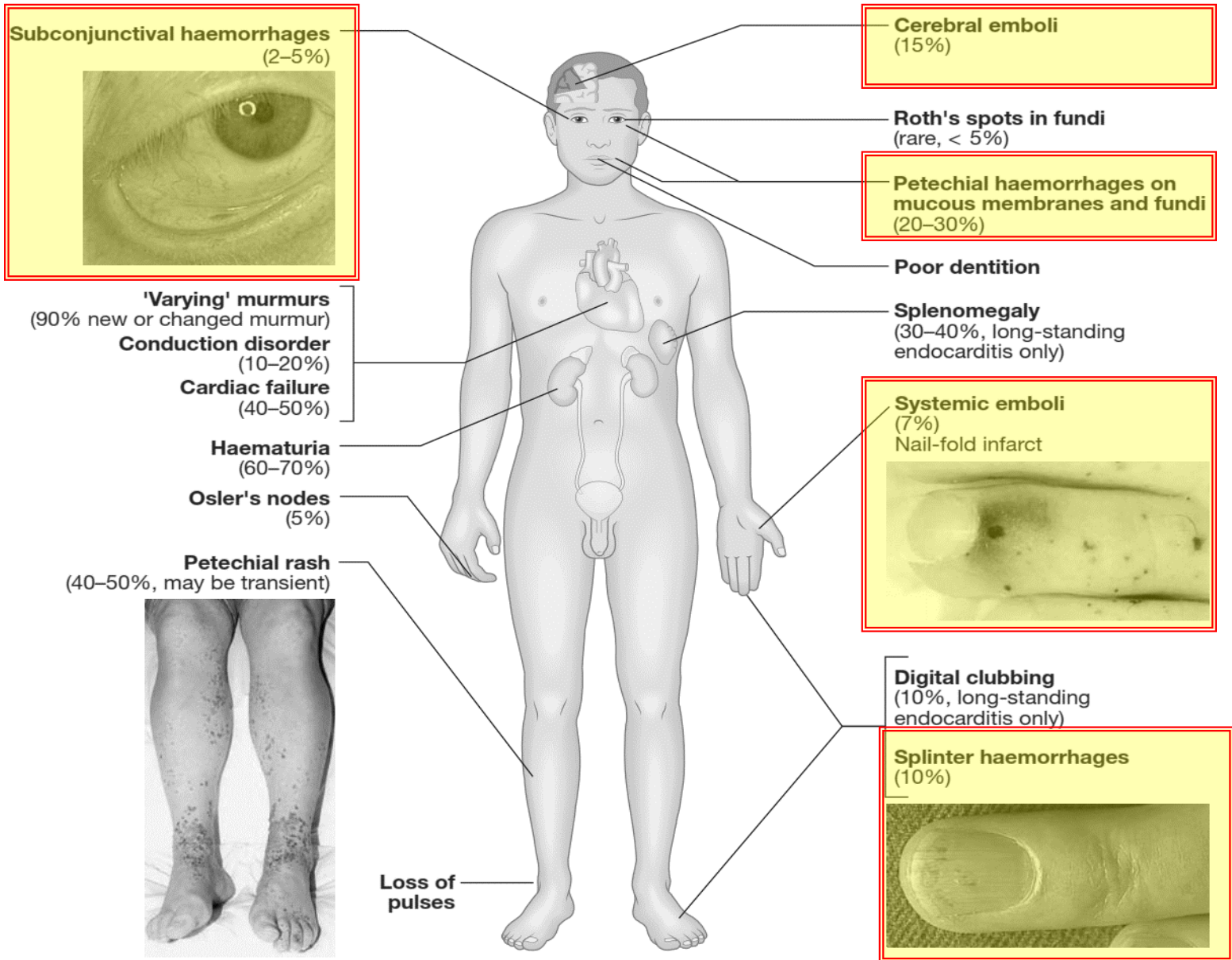


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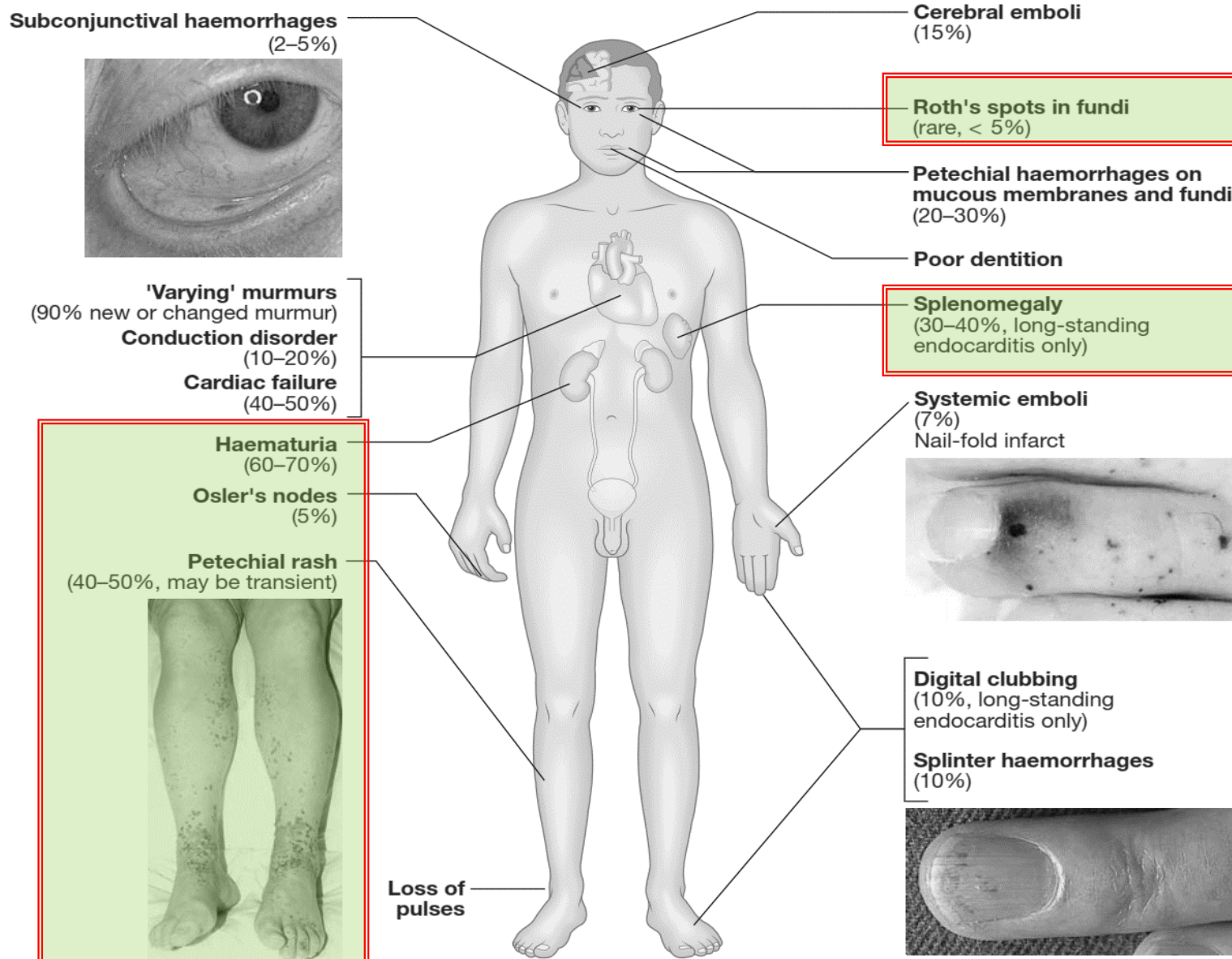
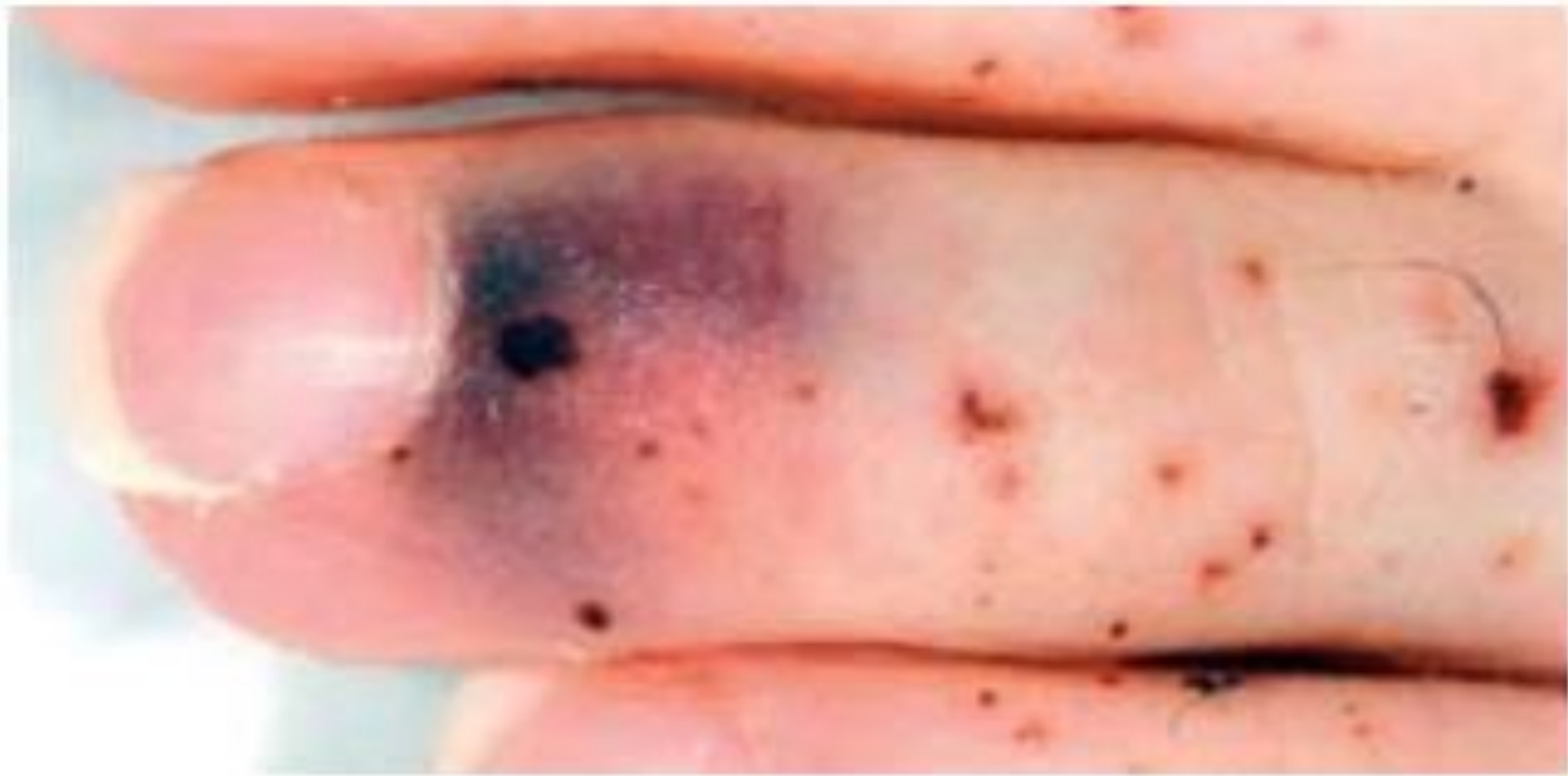
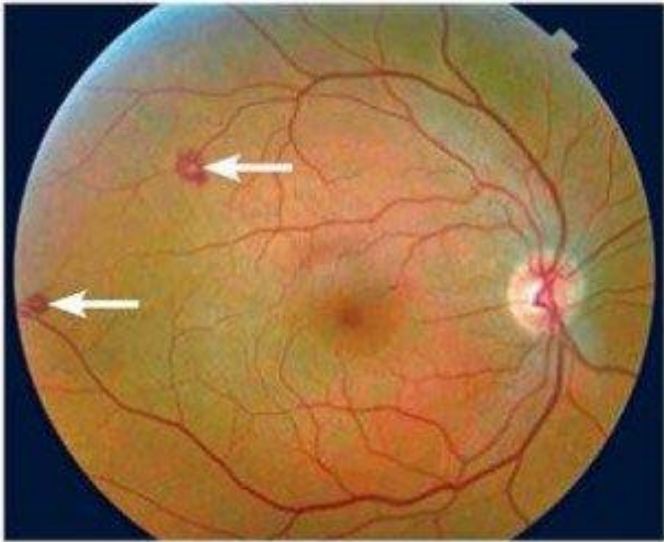


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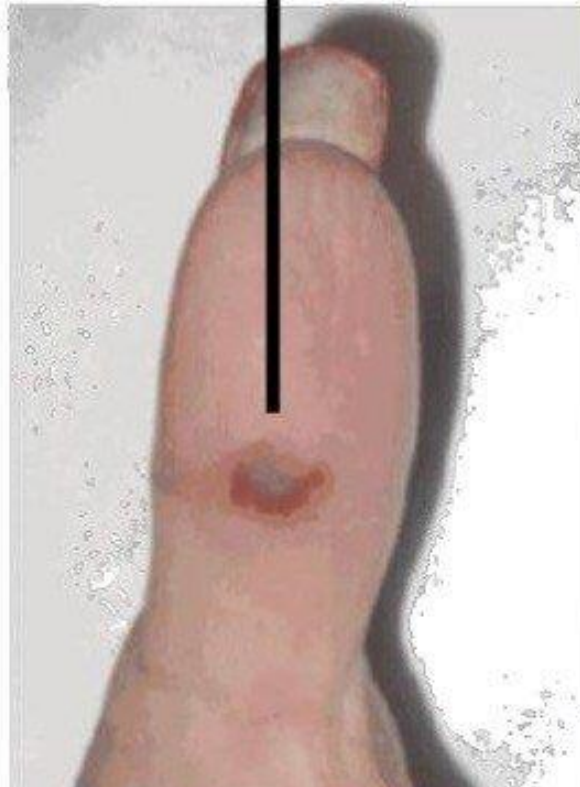


Roth spots



Splinter hemorrhages

Osler Node



Janeway Lesion



i**16.95 Diagnosis of infective endocarditis*****Major criteria****Positive blood culture**

- ~~Typical~~ organism from two cultures
- Persistent positive blood cultures taken >12 hrs apart
- Three or more positive cultures taken over >1 hr


Endocardial involvement

- Positive echocardiographic findings of vegetations
- New valvular regurgitation

Minor criteria

- Predisposing valvular or cardiac abnormality
- Intravenous drug misuse
- Pyrexia $\geq 38^{\circ}\text{C}$
- Embolic phenomenon
- Vasculitic phenomenon
- Blood cultures suggestive: organism grown but not achieving major criteria
- Suggestive echocardiographic findings

*Modified Duke criteria. Patients with two major, or one major and three minor, or five minor have definite endocarditis. Patients with one major and one minor, or three minor have possible endocarditis.

- 
- Staphylococcus aureus
 - Viridans streptococci
 - Streptococcus gallolyticus
 - Enterococci (in the absence of a primary focus)
 - HACEK group

UPDATES IN MAJOR CRITERIA OF IE

2. Imaging positive for IE

a. Echocardiogram positive for IE:

- Vegetation
- Abscess, pseudoaneurysm, intracardiac fistula
- Valvular perforation or aneurysm
- New partial dehiscence of prosthetic valve

b. Abnormal activity around the site of prosthetic valve implantation detected by ^{18}F -FDG PET/CT (only if the prosthesis was implanted for >3 months) or radiolabelled leukocytes SPECT/CT.

c. Definite paravalvular lesions by cardiac CT.



16.95 Diagnosis of infective endocarditis*

Major criteria

Positive blood culture

- Typical organism from two cultures

- P

- T

Endo

- P

- N

Minor

- P

- Intravenous drug misuse

- Pyrexia $\geq 38^{\circ}\text{C}$

- Embolic phenomenon

- Vasculitic phenomenon

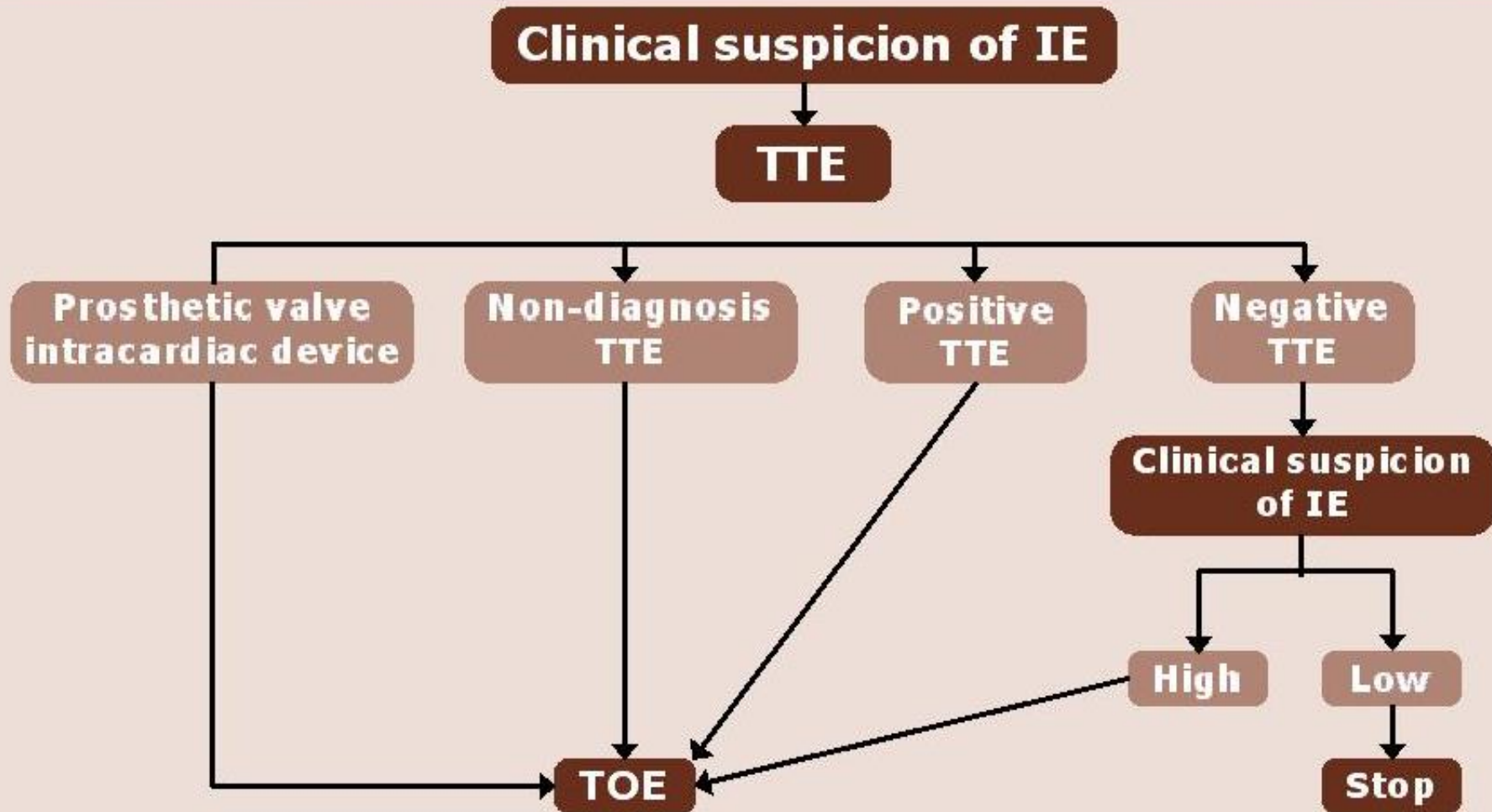
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- Suggestive echocardiographic findings

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Indications for echocardiography



If initial TOE is negative but high suspicion for IE remains, repeat TTE and/or TOE within 5-7 days

***The ECG** may show the development of AV block (due to aortic root abscess formation) and occasionally infarction due to emboli.

***The chest X-ray** may show evidence of cardiac failure and cardiomegaly.

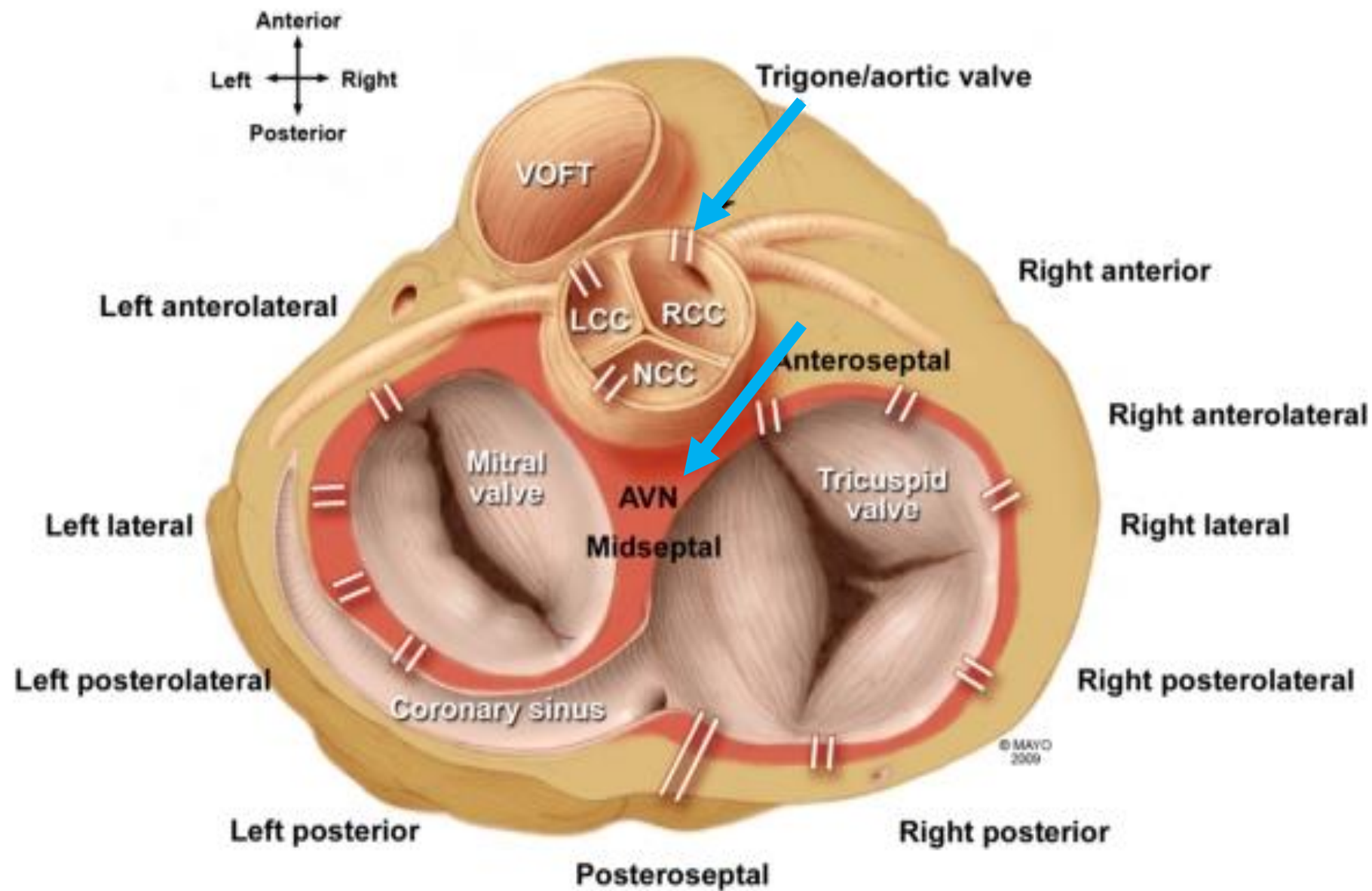
***Blood tests** : Positive Rheumatoid factor (immune phenomenon) , elevation of the ESR, CRP , a normocytic normochromic anaemia, and leucocytosis are common but not invariable.

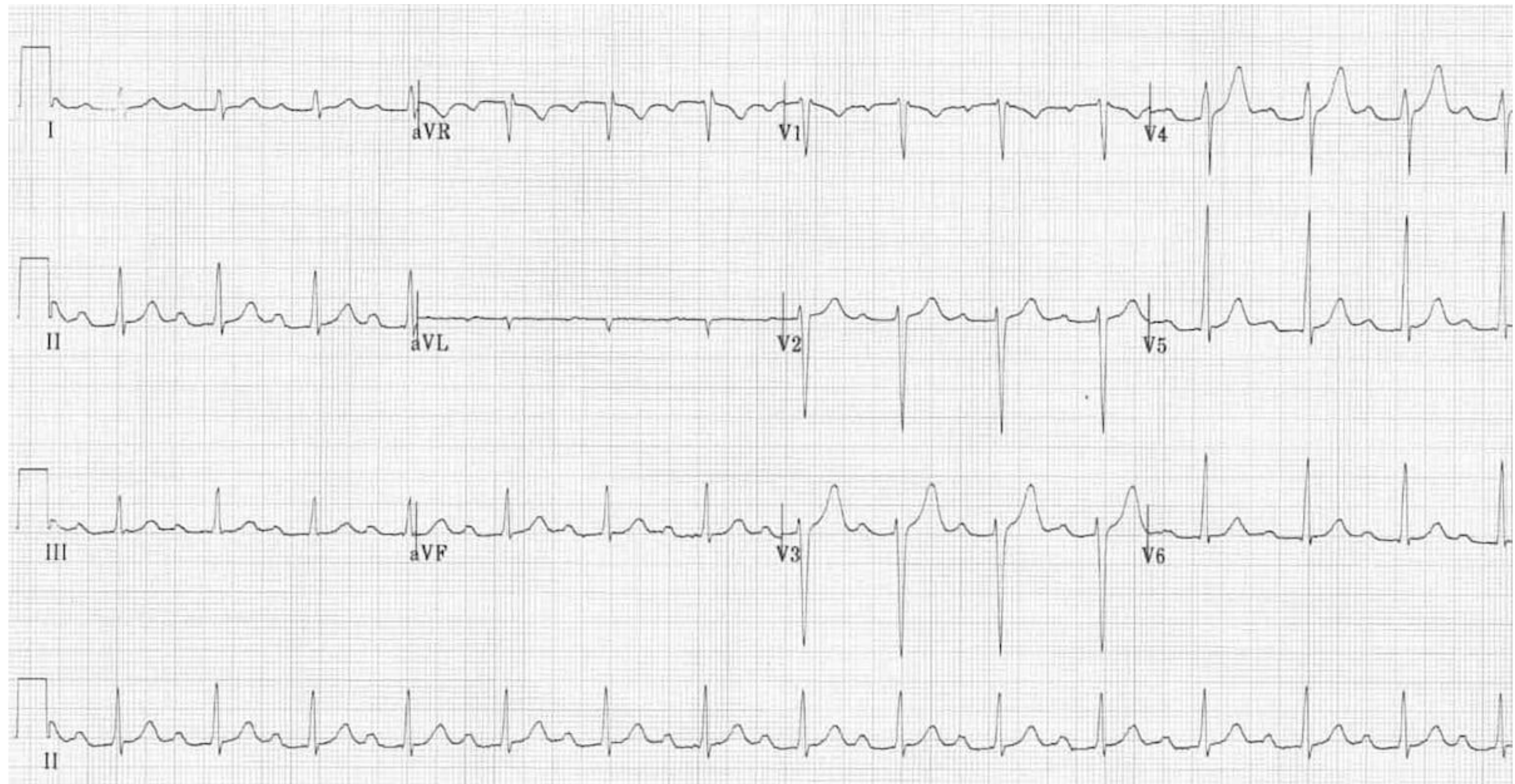
***General urine examination**: Proteinuria and non-visible haematuria (Glomerulonephritis)

Rejected IE

- Firm alternate diagnosis; or
- Resolution of symptoms suggesting IE with antibiotic therapy for ≤ 4 days; or
- No pathological evidence of IE at surgery or autopsy, with antibiotic therapy for ≤ 4 days; or
- Does not meet criteria for possible IE, as above

Accessory Pathway Locations





Empirical treatment

❖ Subacute presentation :

Antibiotic treatment should ideally be withheld until the results of blood cultures are available.

❖ Acute presentation :

Intially, empirical therapy should be started, after blood samples for blood culture are drawn, with:

- Native valve endocarditis : **vancomycin IV + gentamicin IV**
- Prosthetic valve endocarditis : **vancomycin IV + gentamicin IV + rifampicin orally.**

Then, Specific treatment : Results of blood culture and sensitivity (MIC = minimum inhibitory concentration of drugs) help to guide antibiotic therapy

| Antimicrobial susceptibility | Antimicrobial | Dose | Duration | |
|---|---|--|--|---|
| | | | Native valve | Prosthetic valve |
| Streptococci Penicillin MIC ≤ 0.125 mg/L Penicillin MIC > 0.125 , ≤ 0.5 mg/L Penicillin MIC > 0.5 mg/L | Benzylpenicillin IV Benzylpenicillin IV and gentamicin IV Vancomycin IV and gentamicin IV | 1.2 g 6 times daily 2.4 g 6 times daily 1 mg/kg twice daily ² 1 g twice daily ³ 1 mg/kg twice daily ² | 4 weeks ¹ 4 weeks 2 weeks 4 weeks 4 weeks | 6 weeks 6 weeks 2 weeks 6 weeks 6 weeks |
| Enterococci Amoxicillin MIC ≤ 4 mg/L and gentamicin MIC ≤ 128 mg/L Amoxicillin MIC > 4 mg/L and gentamicin MIC ≤ 128 mg/L | Amoxicillin IV and gentamicin IV ² Vancomycin IV and gentamicin IV ² | 2 g 6 times daily 1 mg/kg twice daily ² 1 g twice daily ³ 1 mg/kg twice daily ² | 4 weeks 4 weeks 4 weeks 4 weeks | 6 weeks 6 weeks 6 weeks 6 weeks |
| Staphylococci – native valve Meticillin-sensitive Meticillin-resistant, vancomycin MIC ≤ 2 mg/L, rifampicin-sensitive | Flucloxacillin IV Vancomycin IV Rifampicin orally | 2 g 4–6 times daily ⁴ 1 g twice daily ³ 300–600 mg twice daily | 4 weeks 4 weeks 4 weeks | – – – |
| Staphylococci – prosthetic valve Meticillin-sensitive Meticillin-resistant, vancomycin MIC ≤ 2 mg/L, rifampicin-sensitive | Flucloxacillin IV and gentamicin IV and rifampicin orally Vancomycin IV and rifampicin orally | 2 g 4–6 times daily 1 mg/kg twice daily ² 300–600 mg twice daily 1 g twice daily ³ 300–600 mg twice daily | – – – – – | 6 weeks 6 weeks 6 weeks 6 weeks 6 weeks |

¹When conditions in Box 16.97 are met, 2 weeks of benzylpenicillin and gentamicin (1 mg/kg twice daily) may be sufficient. Ceftriaxone 2 g once daily IV/IM can be used instead of benzylpenicillin for those with non-severe penicillin allergy. ²Pre-dose gentamicin level should be ≤ 1 mg/L, post-dose 3–5 mg/L. Adjust dose according to levels and renal function. ³Pre-dose vancomycin level should be 15–20 mg/L. Adjust dose according to levels and renal function. ⁴Use 6 times daily if weight > 85 kg. (IV = intravenous; MIC = minimum inhibitory concentration)

Adapted from Gould FK, Denning DW, Elliott TS, et al. Guidelines for the diagnosis and antibiotic treatment of endocarditis in adults: a report of the working party of the British Society for Antimicrobial Chemotherapy. *J Antimicrob Chemother* 2012; 67:269–289.

| Antimicrobial susceptibility | Antimicrobial | Dose | Duration | |
|---|---|---|----------------------|-------------------------------|
| | | | Native valve | Prosthetic valve |
| Streptococci | | | | |
| Penicillin MIC ≤ 0.125 mg/L | Benzylpenicillin IV | 1.2 g 6 times daily | 4 weeks ¹ | 6 weeks |
| Penicillin MIC > 0.125 , ≤ 0.5 mg/L | Benzylpenicillin IV and gentamicin IV | 2.4 g 6 times daily 1 mg/kg twice daily ² | 4 weeks 2 weeks | 6 weeks 2 weeks |
| Penicillin MIC > 0.5 mg/L | Vancomycin IV and gentamicin IV | 1 g twice daily ³ 1 mg/kg twice daily ² | 4 weeks 4 weeks | 6 weeks 6 weeks |
| Enterococci | | | | |
| Amoxicillin MIC ≤ 4 mg/L and gentamicin MIC ≤ 128 mg/L | Amoxicillin IV and gentamicin IV ² | 2 g 6 times daily 1 mg/kg twice daily ² | 4 weeks 4 weeks | 6 weeks 6 weeks |
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| Staphylococci – native valve | | | | |
| Meticillin-sensitive | Flucloxacillin IV | 2 g 4–6 times daily ⁴ | 4 weeks | – |
| Meticillin-resistant, vancomycin MIC ≤ 2 mg/L, rifampicin-sensitive | Vancomycin IV Rifampicin orally | 1 g twice daily ³ 300–600 mg twice daily | 4 weeks 4 weeks | – – |
| Staphylococci – prosthetic valve | | | | |
| Meticillin-sensitive | Flucloxacillin IV and gentamicin IV and rifampicin orally | 2 g 4–6 times daily 1 mg/kg twice daily ² 300–600 mg twice daily | – – – | 6 weeks 6 weeks 6 weeks |
| Meticillin-resistant, vancomycin MIC ≤ 2 mg/L, rifampicin-sensitive | Vancomycin IV and rifampicin orally | 1 g twice daily ³ 300–600 mg twice daily | – – | 6 weeks 6 weeks |

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16.98 Indications for cardiac surgery in infective endocarditis*

- Heart failure due to valve damage
- Failure of antibiotic therapy (persistent/uncontrolled infection)
- Large vegetations on left-sided heart valves with echo appearance suggesting high risk of emboli
- Previous evidence of systemic emboli
- Abscess formation

*Patients with prosthetic valve endocarditis or fungal endocarditis often require cardiac surgery.

IE prophylaxis:

- ***Antibiotic prophylaxis***
- ***Non specific preventive measures***

A/Antibiotic prophylaxis:

Cardiac conditions

High risk

for infective endocarditis

+

Procedures

High risk

for infective endocarditis

High risk cardiac conditions :

Antibiotic prophylaxis should only be considered for:

- (1) Prosthetic valve
- (2) Previous episode of IE.
- (3) CHD (congenital heart disease)
 - (a) Cyanotic CHD.
 - (b) CHD repaired with a prosthetic material
(up to 6 months if complete repair / lifelong if residual shunt remains.)

High risk procedures :

Antibiotic prophylaxis *should only be considered for:*

Dental procedures requiring :

- **manipulation of the gingival or periapical region of the teeth**
- **or perforation of the oral mucosa**

While Antibiotic prophylaxis is NOT recommended for

1. Other dental procedures :

local anaesthetic injections in non-infected tissues, treatment of superficial caries, removal of sutures, dental X-rays, placement or adjustment of removable prosthodontic or orthodontic appliances or braces or following the shedding of deciduous teeth or trauma to the lips and oral mucosa

1. Respiratory tract procedures
2. Gastrointestinal or urogenital procedures
3. Skin and soft tissue procedures

Recommended prophylaxis for high-risk dental procedures in high-risk patients

| Situation | Antibiotic | Single-dose 30–60 minutes before procedure | |
|--|--|--|-------------------------|
| | | Adults | Children |
| No allergy to penicillin or ampicillin | Amoxicillin or ampicillin ^a | 2 g orally or i.v. | 50 mg/kg orally or i.v. |
| Allergy to penicillin or ampicillin | Clindamycin | 600 mg orally or i.v. | 20 mg/kg orally or i.v. |

^aAlternatively, cephalexin 2 g i.v. for adults or 50 mg/kg i.v. for children, cefazolin or ceftriaxone 1 g i.v. for adults or 50 mg/kg i.v. for children.

Cephalosporins should not be used in patients with anaphylaxis, angio-oedema, or urticaria after intake of penicillin or ampicillin due to cross-sensitivity.

B/Non-specific prevention measures

These measures should ideally be applied to the general population and particularly **reinforced in high-risk patients**:

- Strict dental and cutaneous hygiene. Dental follow-up should be performed **twice a year in high-risk patients and yearly in the others**.
- Disinfection of wounds.
- Curative antibiotics for any focus of bacterial infection.
- No self-medication with antibiotics.
- Strict infection control measures for any at-risk procedure.
- Discourage piercing and tattooing.

Non infective endocarditis:

Libman-Sacks endocarditis characterise which of the followings:

A-Rheumatoid arthritis

B- SLE

C- Scleroderma

D- Bahcet disease

Non infective endocarditis:

Marantic endocarditis characterise which of the followings:

A- DIC

B- Metastatic carcinomas

C- Chronic infection like TB

D- All of the above

Q // 40 years old female, hypertensive presented with 4 weeks history of **fever, night sweating and hand pain.**

Clinical examination :

Pallor

Temperature 39 C , BP= 150/90 , HR=100 regular

Precordial examination : Grade 2 **systolic murmur at apex with soft S1**

Abdominal examination : Mild **splenomegaly**

Hands examination : **arthritis of interphalangeal and metacarpophalangeal joints**

Echocardiography : thickened prolapsed mitral valve leaflets with **vegetations and moderate mitral regurgitation**



THANK YOU