Infective Endocarditis

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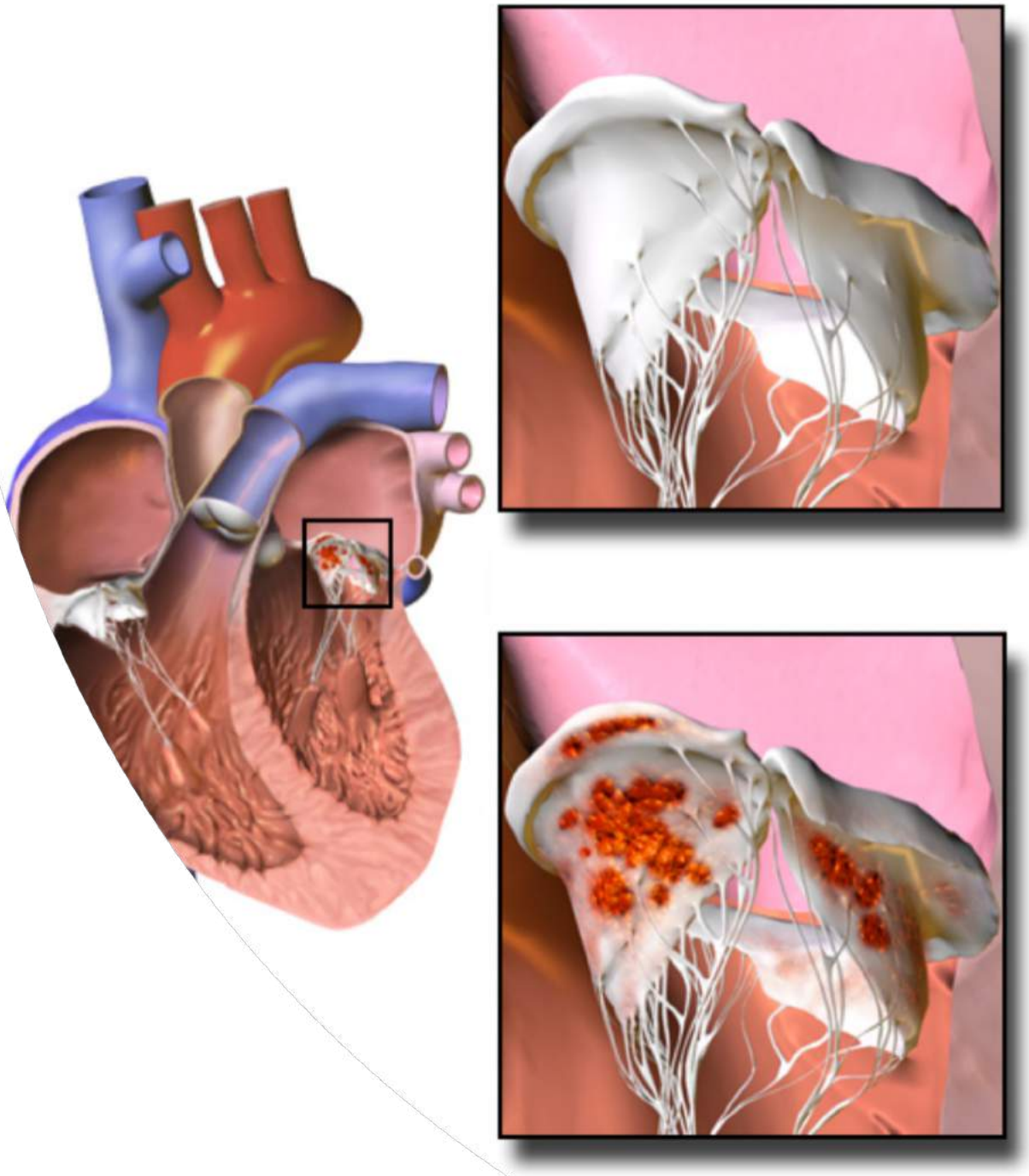


Objectives

- 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

Agenda

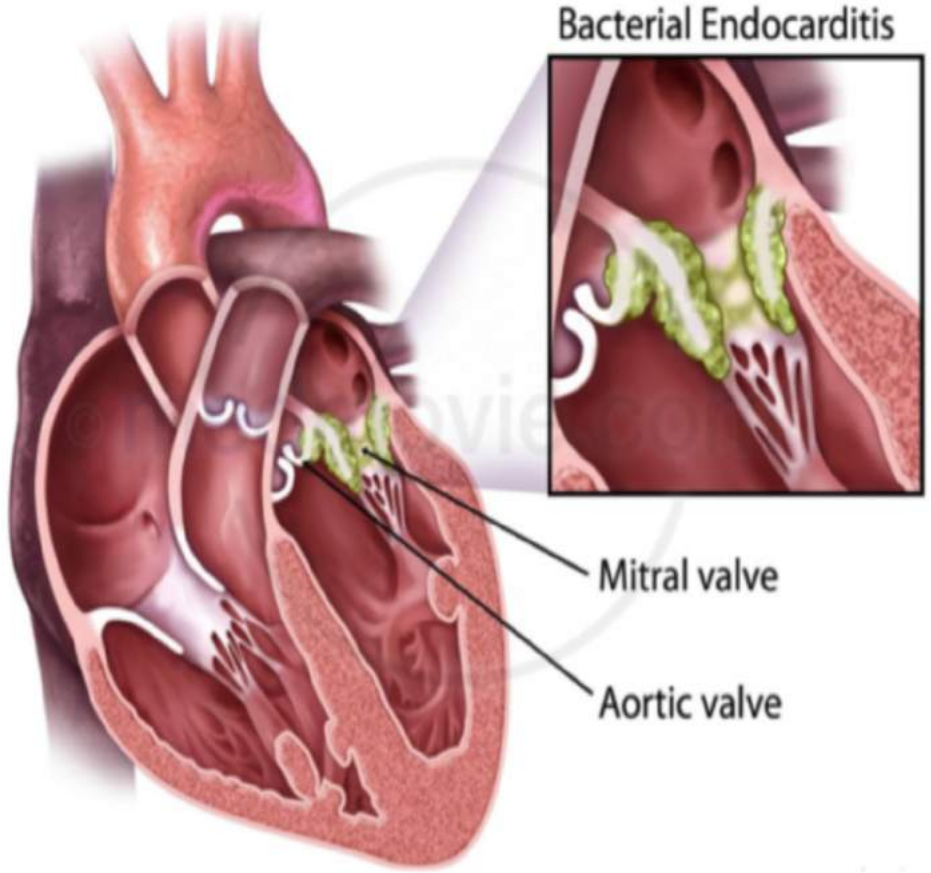
- What is IE ?
- Epidemiology
- Microbiology
- Pathogensis
- Risk Factors
- Clinical presentation
- Diagnostic criteria
- Complications
- Investigations
- Management
- Prophylaxis

What is infective Endocarditis ?

- An infection of the **endocardial surface** of the heart, which may include one or more heart valves (native or prosthetic), the mural endocardium, a septal defect or an intracardiac device.

- This leads to formation of bulky friable **vegetations** composed of thrombotic debris and organisms.

- Often associated with destruction of the underlying cardiac tissue



Epidemiology

- Heavily influenced by the epidemiology of the infection.
- Developing countries (endemic RF), Subacute course, viridans group streptococci.
- Developed countries, acute illness, *Staphylococcus aureus*, with numerous anatomic sites of metastatic foci of infection and worse outcomes.

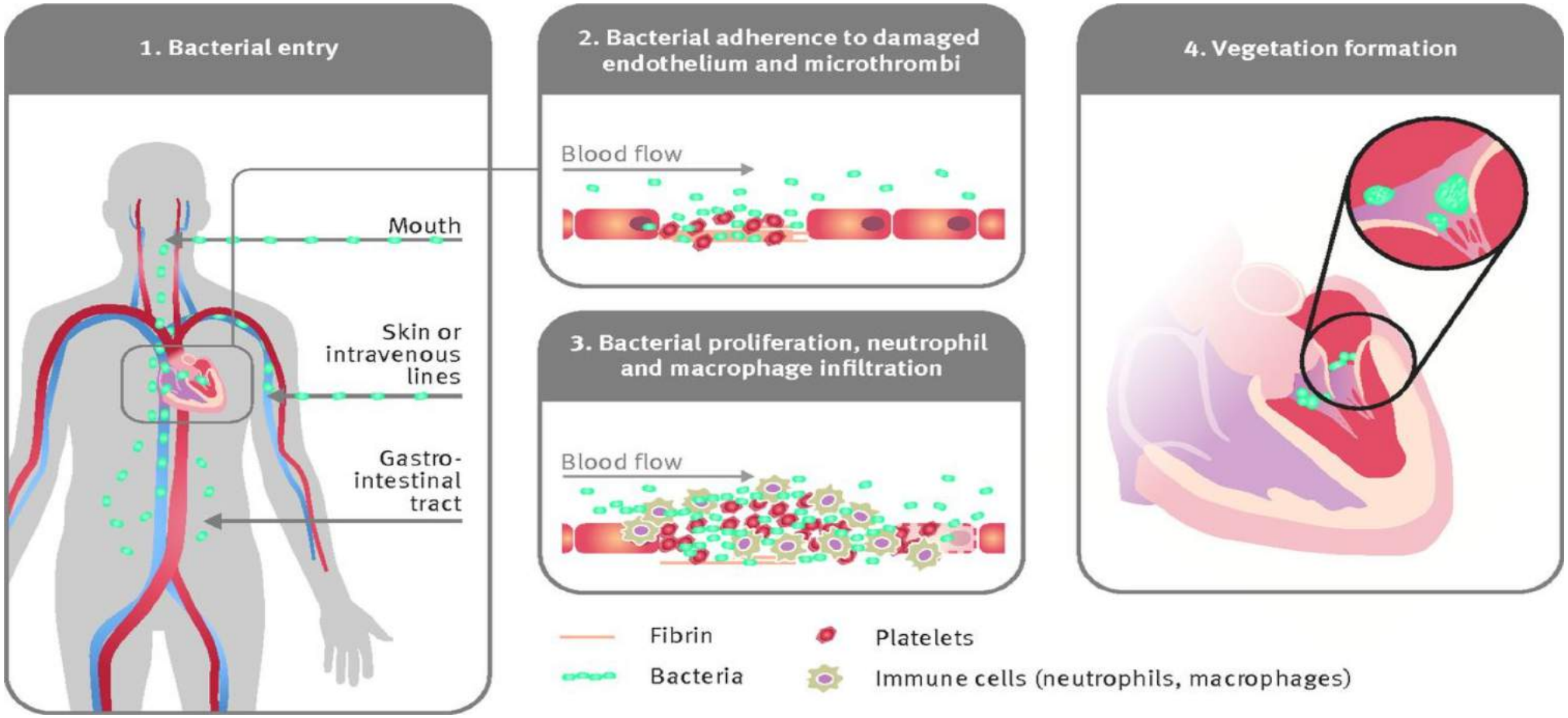
Epidemiology

- IE develops most commonly on the mitral valve, closely followed in descending order of frequency by the aortic valve, combined mitral & aortic valve, tricuspid valve & rarely, the pulmonic valve.

- Mechanical prosthetic & bioprosthetic valves exhibit equal rates of infection.

- More common in males

Pathogenesis of infective endocarditis



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Risk Factors

Patient Factors	Comorbid Conditions
• Age >60 years	• Structural heart disease
• Male sex	• Valvular disease
• Injection drug use	• Congenital heart disease
• Poor dentition or dental infection	• Prosthetic heart valve(s)/TAVR
	• History of infective endocarditis
	• Intravascular device
	• Cardiac implantable electronic device
	• Chronic hemodialysis
	• HIV infection

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Microbiology

- Vary depending on the population e.g IV drug abuser, pts with PHV, hospital acquired vs community acquired.
- The three most common causes of IE worldwide are staphylococci, streptococci & enterococci.
- In the US & most developed countries, *Staph. aureus* is the most common cause of IE
- Staphylococcal IE is a common cause of health care-associated IE
- Streptococcal IE is a common cause of community-acquired IE .

Microbiology

Staph aureus (Including MRSA)	• 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. bovis (gallolyticus)	• GI flora associated with polyps and colon cancer • Subacute endocarditis • Highly sensitive to penicillin
Beta- hemolytic stept group (A-B-C-G)	• Frequent intracardiac & extracardiac complications, abcesses
Enterococci (fecalis, faecium)	• GI flora • Associated with UTI/ nosocomial infection

Microbiology

HACEK: • **Hemophilus sp** • **Aggregatibacter sp (actinobacillus)** • **Cardiobacterium hominis** • **Eikenella corrodens** • **Kingella sp.**	• Fastidious gram-negative bacilli • URTI – oropharyngeal flora • Positive blood culture after 5 days of incubation & maybe longer • Large vegetation
Other micro-organisms (can cause culture negative endocarditis)	• **Coxiella burnetti** (Q fever): subacute endocarditis, elevate Igg titer • **Bartonella:** culture negative endocardiris (perform serology or specific culture technique), cat scratch disease • **Fungi (candida)** risk factors immunosuppression, prosthesis, central line, IVDA, invasive endocarditis • **Others:** Brucella, tropheryma whipplei, Mycoplasma, legionella

Epidemiological Clues That May be Helpful in Defining the Etiological Dx of CNE

Epidemiological Feature	Common Microorganism
IDU	*S aureus*, including community-acquired oxacillin-resistant strains
	Coagulase-negative staphylococci
	β-Hemolytic streptococci
	Fungi
	Aerobic Gram-negative bacilli, including *Pseudomonas aeruginosa*
	Polymicrobial
Indwelling cardiovascular medical devices	*S aureus*
	Coagulase-negative staphylococci
	Fungi
	Aerobic Gram-negative bacilli
	Corynebacterium sp
Genitourinary disorders, infection, and manipulation, including pregnancy, delivery, and abortion	*Enterococcus* sp
	Group B streptococci (*S agalactiae*)
	Listeria monocytogenes
	Aerobic Gram-negative bacilli
	Neisseria gonorrhoeae
Chronic skin disorders, including recurrent infections	*S aureus*
	β-Hemolytic streptococci
Poor dental health, dental procedures	VGS
	Nutritionally variant streptococci
	Abiotrophia defectiva
	Granulicatella sp
	Gemella sp
	HACEK organisms
Alcoholism, cirrhosis	*Bartonella* sp
	Aeromonas sp
	Listeria sp
	S pneumoniae
	β-Hemolytic streptococci
Burn	*S aureus*
	Aerobic Gram-negative bacilli, including *P aeruginosa*
	Fungi
Diabetes mellitus	*S aureus*
	β-Hemolytic streptococci
	S pneumoniae
Early (≤1 y) prosthetic valve placement	Coagulase-negative staphylococci
	S aureus
	Aerobic Gram-negative bacilli
	Fungi
	Corynebacterium sp
	Legionella sp
Late (>1 y) prosthetic valve placement	Coagulase-negative staphylococci
	S aureus
	Viridans group streptococci
	Enterococcus species
	Fungi
	Corynebacterium sp

(*Continued*)

Epidemiological Clues That May be Helpful in Defining the Etiological Dx of CNE

Epidemiological Feature	Common Microorganism
Dog or cat exposure	*Bartonella* sp
	Pasteurella sp
	Capnocytophaga sp
Contact with contaminated milk or infected farm animals	*Brucella* sp
	Coxiella burnetii
	Erysipelothrix sp
Homeless, body lice	*Bartonella* sp
AIDS	*Salmonella* sp
	S pneumoniae
	S aureus
Pneumonia, meningitis	*S pneumoniae*
Solid organ transplantation	*S aureus*
	Aspergillus fumigatus
	Enterococcus sp
	Candida sp
Gastrointestinal lesions	*S gallolyticus (bovis)*
	Enterococcus sp
	Clostridium septicum

HACEK indicates *Haemophilus* species, *Aggregatibacter* species, *Cardiobacterium hominis*, *Eikenella corrodens*, and *Kingella* species; IDU, injection drug use; and VGS, viridans group streptococci.

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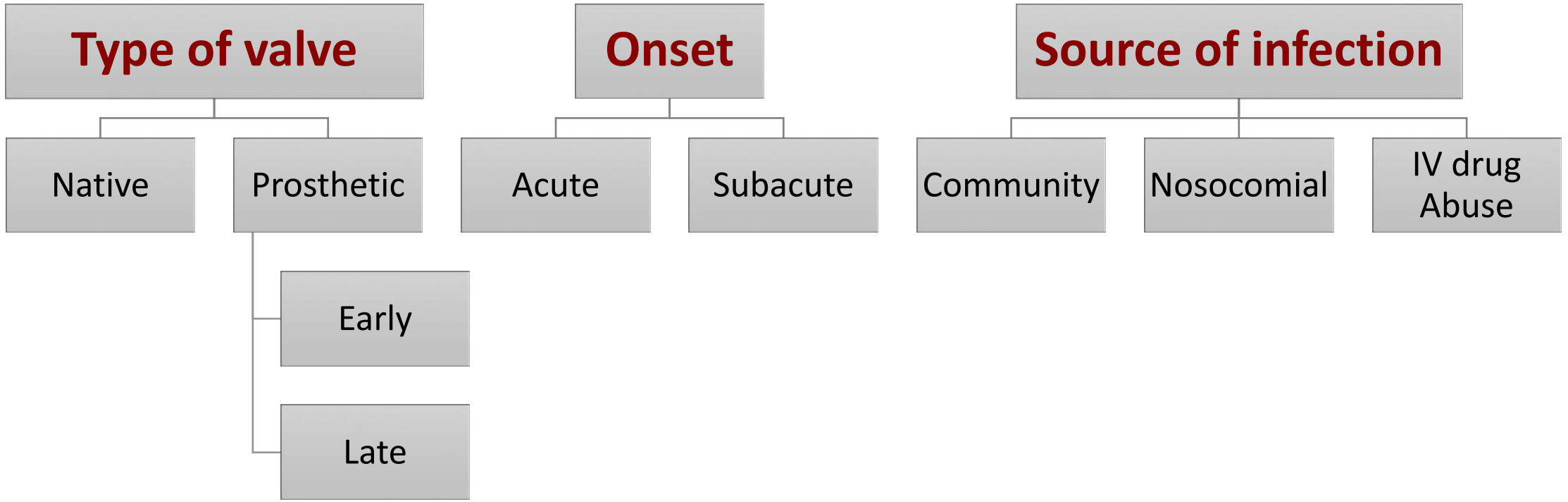
Types of infective endocarditis



Symptoms

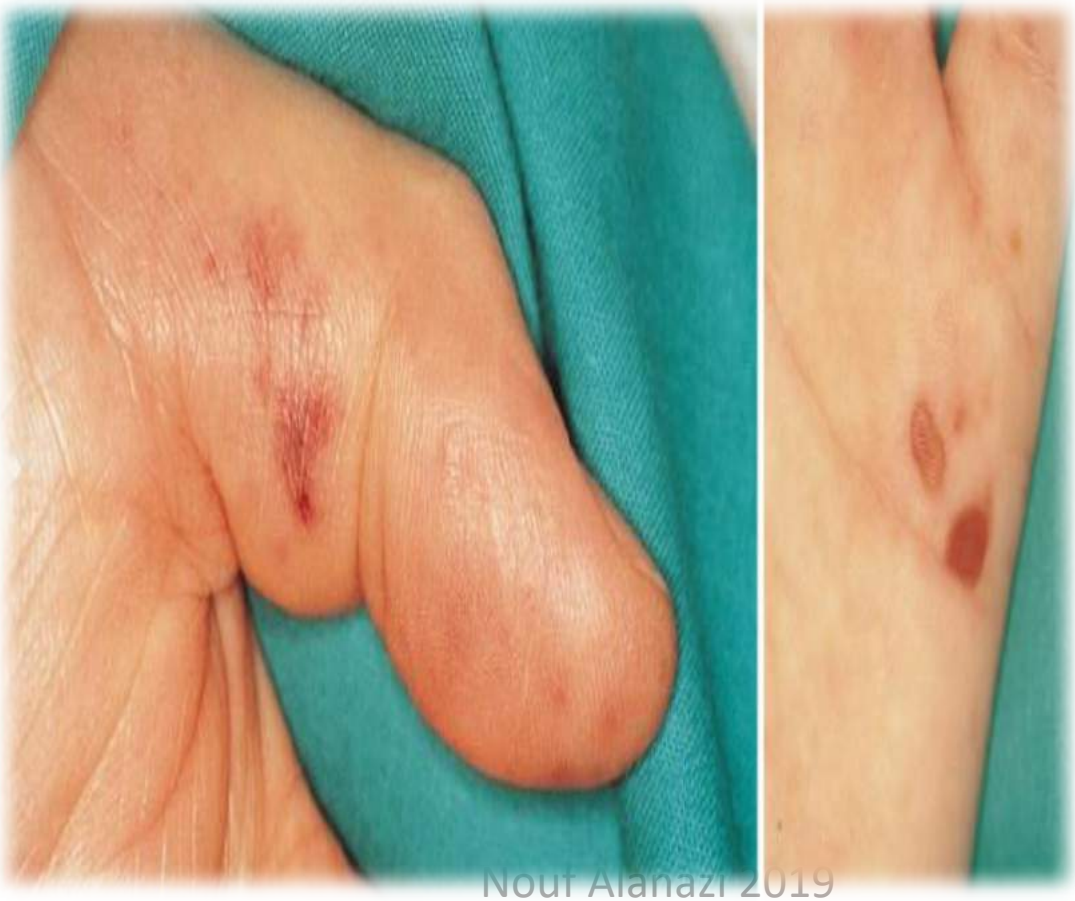
SYMPTOM	PATIENTS AFFECTED (%)
Fever	80-95
Chills	40-70
Weakness	40-50
Malaise	20-40
Sweats	20-40
Anorexia	20-40
Headache	20-40
Dyspnea	20-40
Cough	20-30
Weight loss	20-30
Myalgia/arthralgia	10-30
Stroke	10-20
Confusion/delirium	10-20
Nausea/vomiting	10-20
Edema	5-15
Chest pain	5-15
Abdominal pain	5-15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

Signs

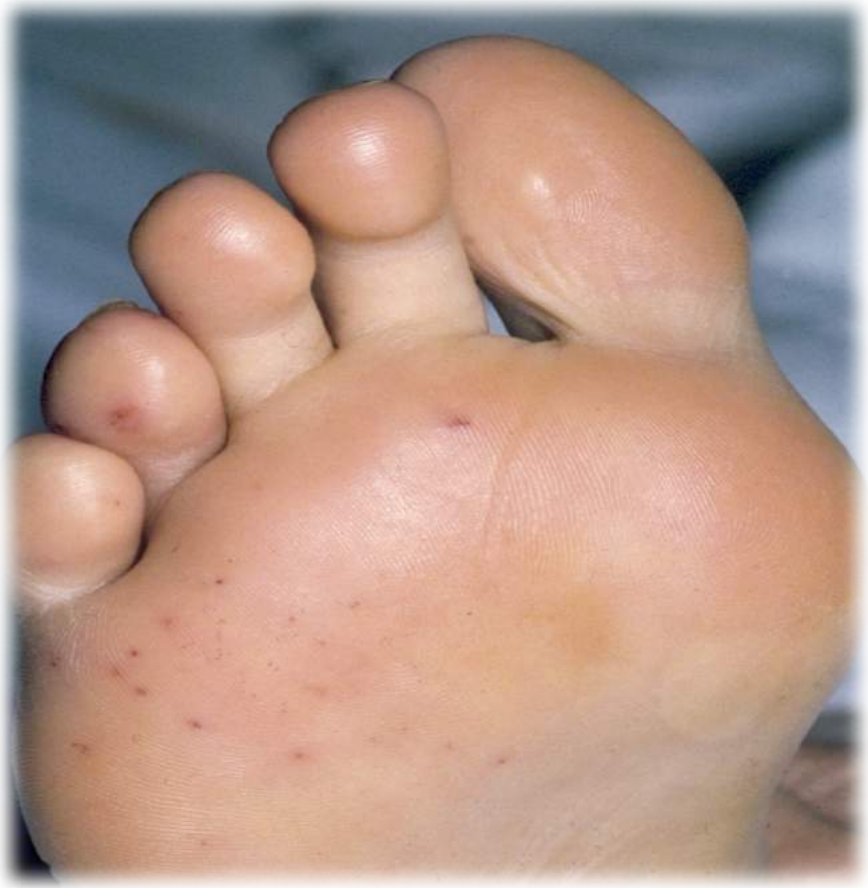
FINDING	PATIENTS AFFECTED (%)
Fever	80-90
Heart murmur	75-85
New murmur	10-50
Changing murmur	5-20
Central neurologic abnormality	20-40
Splenomegaly	10-40
Petechiae/conjunctival hemorrhage	10-40
Splinter hemorrhages	5-15
Janeway lesions	5-10
Osler nodes	3-10
Retinal lesion or Roth spot	2-10

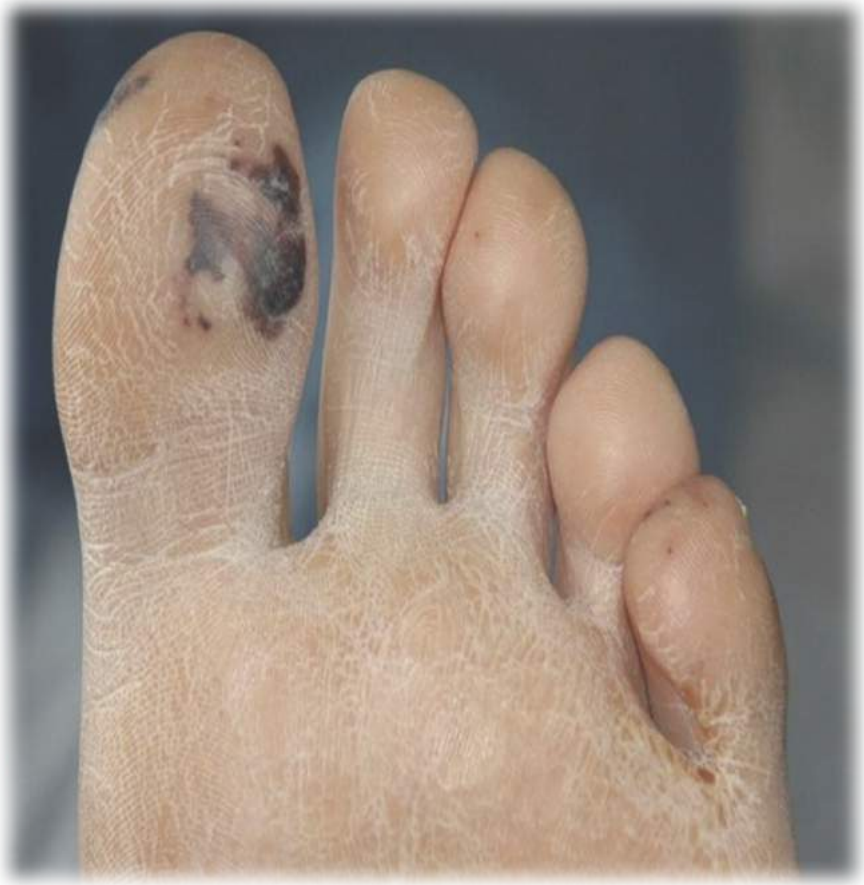
Janeway Lesions

Nontender maculae on the palms and soles



Janeway Lesions





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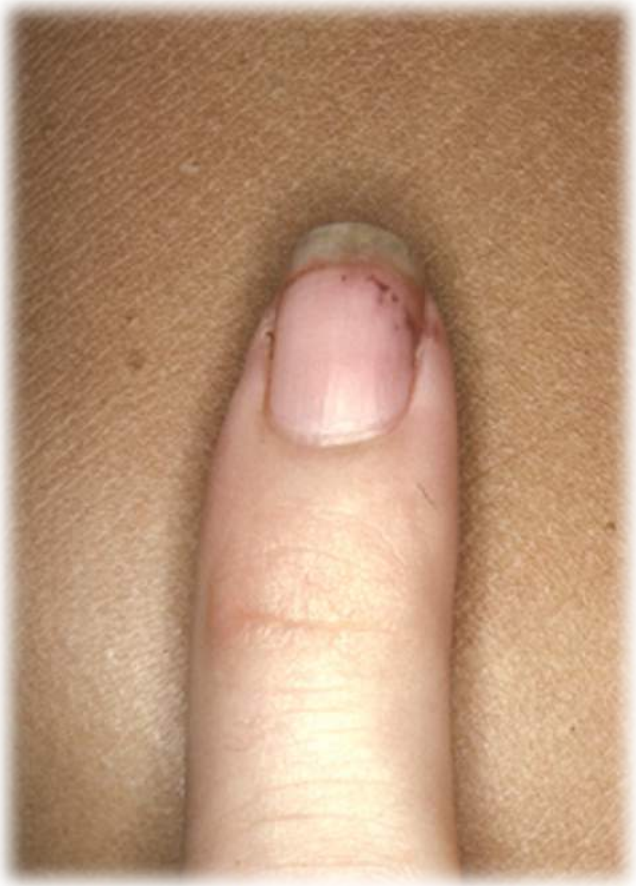
Subungual (splinter) hemorrhages

Dark-red, linear lesions in the nail beds



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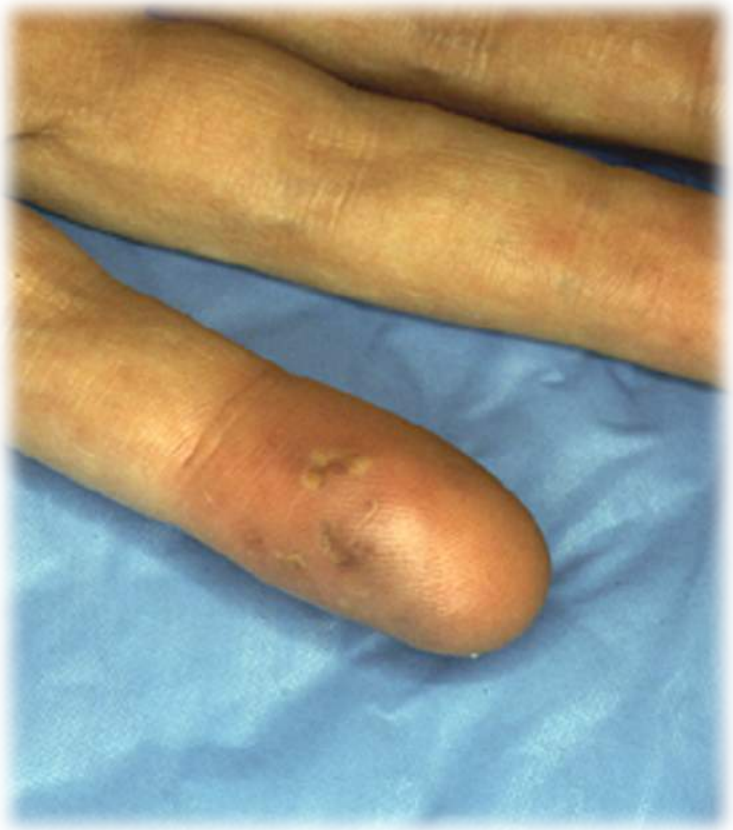
Osler nodes

Tender subcutaneous nodules usually found on the distal pads of the digits



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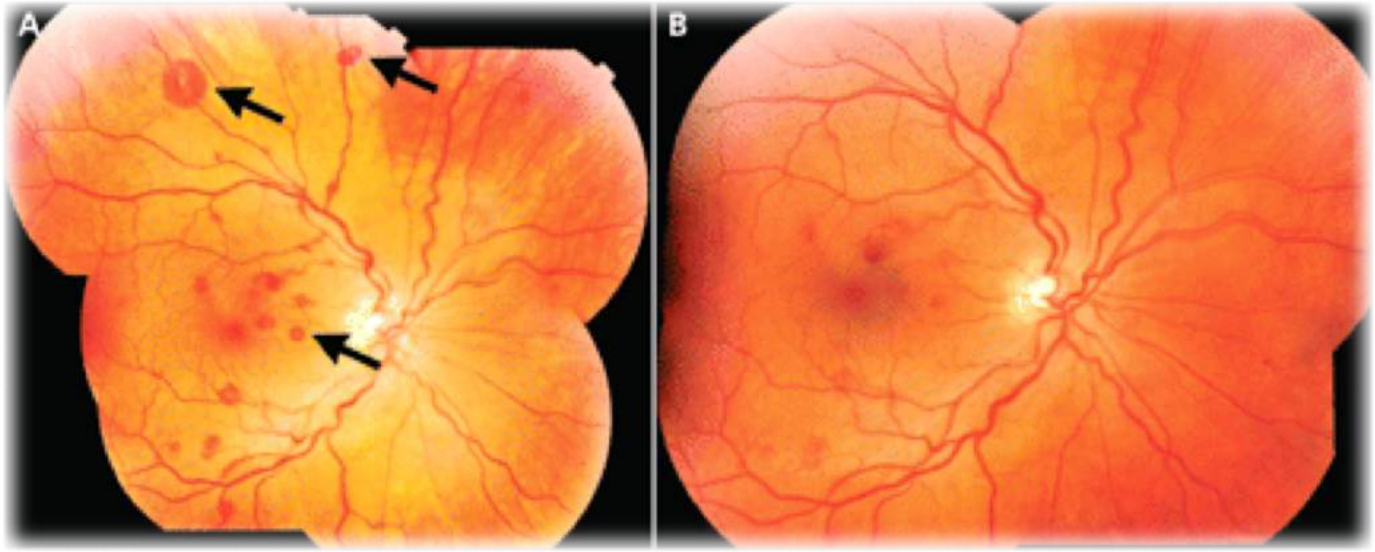
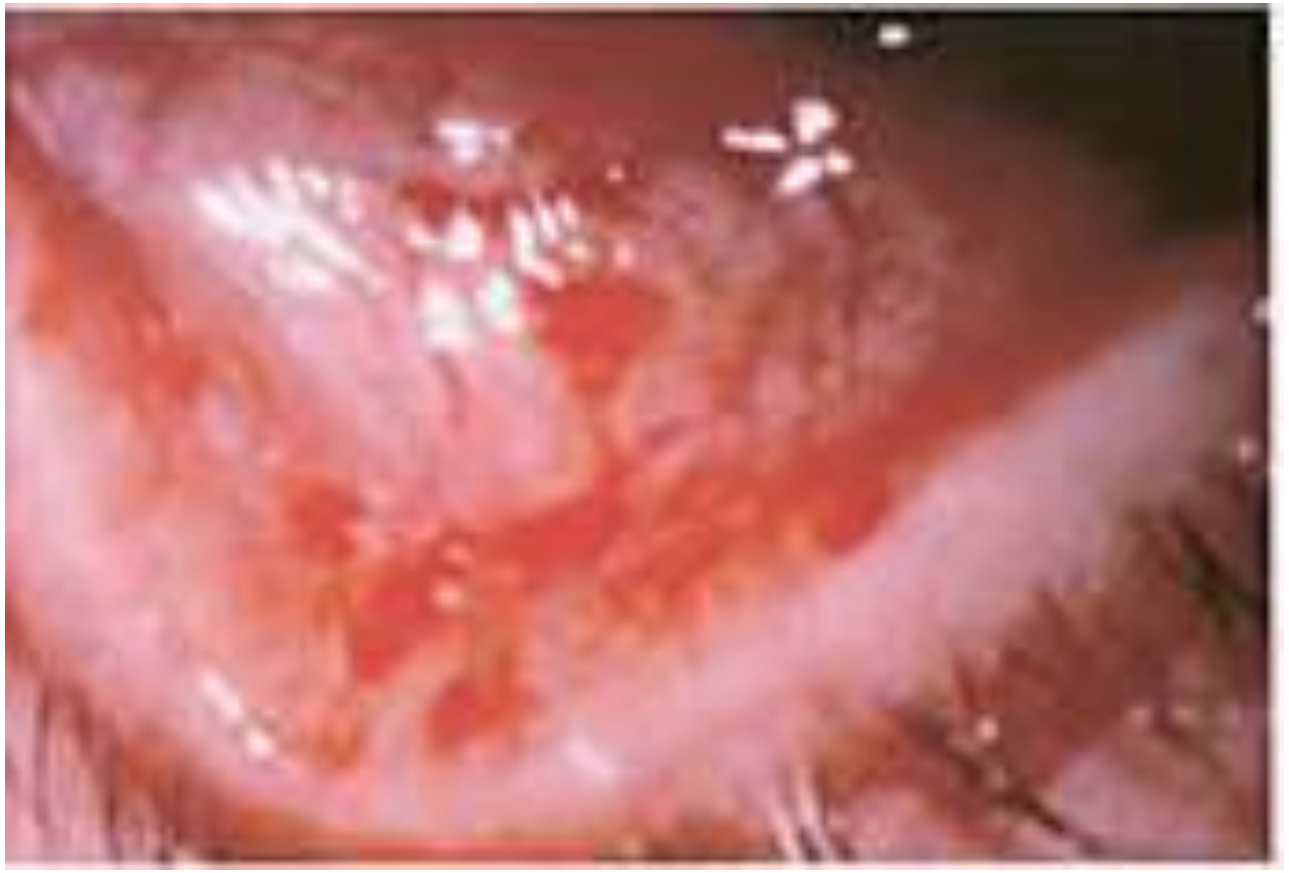
Roth Spots

Retinal red spots with pale (white) center

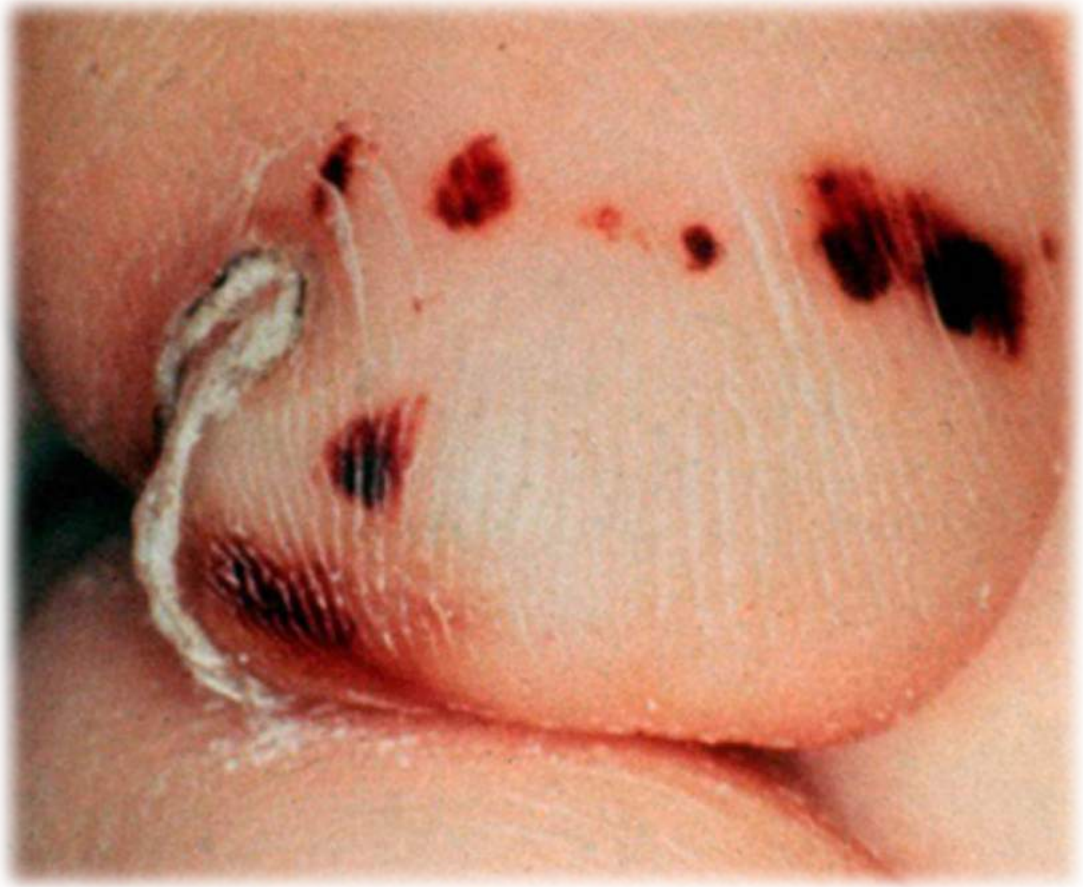


Subconjunctival Hemorrhages



Petechia

Nonblanching, pinpoint reddish brown macules



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Other signs of IE

- Splenomegaly
- Delirium
- Conjunctival hemorrhage
- Pallor
- Cardiac arrhythmia
- Pericardial rub
- Pleural friction rub

IVDA IE

- Skin is the predominant source of infection
- Most commonly affects the TV.
- 70 - 100% of Rt. sided IE results in pneumonia & septic emboli
- Microbiology
  - Staph aureus ~60%
  - Streptococci and Enterococci ~20%
  - Gram -ve bacilli ~10%
  - Fungi (Candida and Aspergillus ~5%

Prosthetic Valve Endocarditis

Early (<12 months)	Late (> 12 months)
• Reflects perioperative contamination • Incidence around 1% • Microbiology: ✓ Staph (45 - 50%) ○ Staph. Epiderm (~ 30%) ○ Staph. Aureus (~ 20%) ✓ Gram -ve aerobes (~20%) ✓ Fungi (~ 10%) ✓ Strep and Entero (5-10%)	• After endothelialization • Incidence 0.2 -0.5 % / pt. year • Transient bacteraemia from dental, GI or GU • Microbiology: resembles native valve endocarditis

Diagnosis

Modified Duke criteria for diagnosis of infective endocarditis - Table A

Definite IE is established in the presence of any of the following:
Pathologic criteria
Pathologic lesions: vegetation or intracardiac abscess demonstrating active endocarditis on histology **OR**
Microorganism: demonstrated by culture or histology of a vegetation or intracardiac abscess
Clinical criteria
Using specific definitions listed in **Table B:**
2 major clinical criteria **OR**
1 major and 3 minor clinical criteria **OR**
5 minor clinical criteria
Possible IE*
Presence of 1 major and 1 minor clinical criteria **OR** presence of 3 minor clinical criteria
Rejected IE
A firm alternate diagnosis is made **OR**
Resolution of clinical manifestations occurs after ≤4 days of antibiotic therapy **OR**
No pathologic evidence of infective endocarditis is found at surgery or autopsy after antibiotic therapy for four days or less
Clinical criteria for possible or definite IE not met

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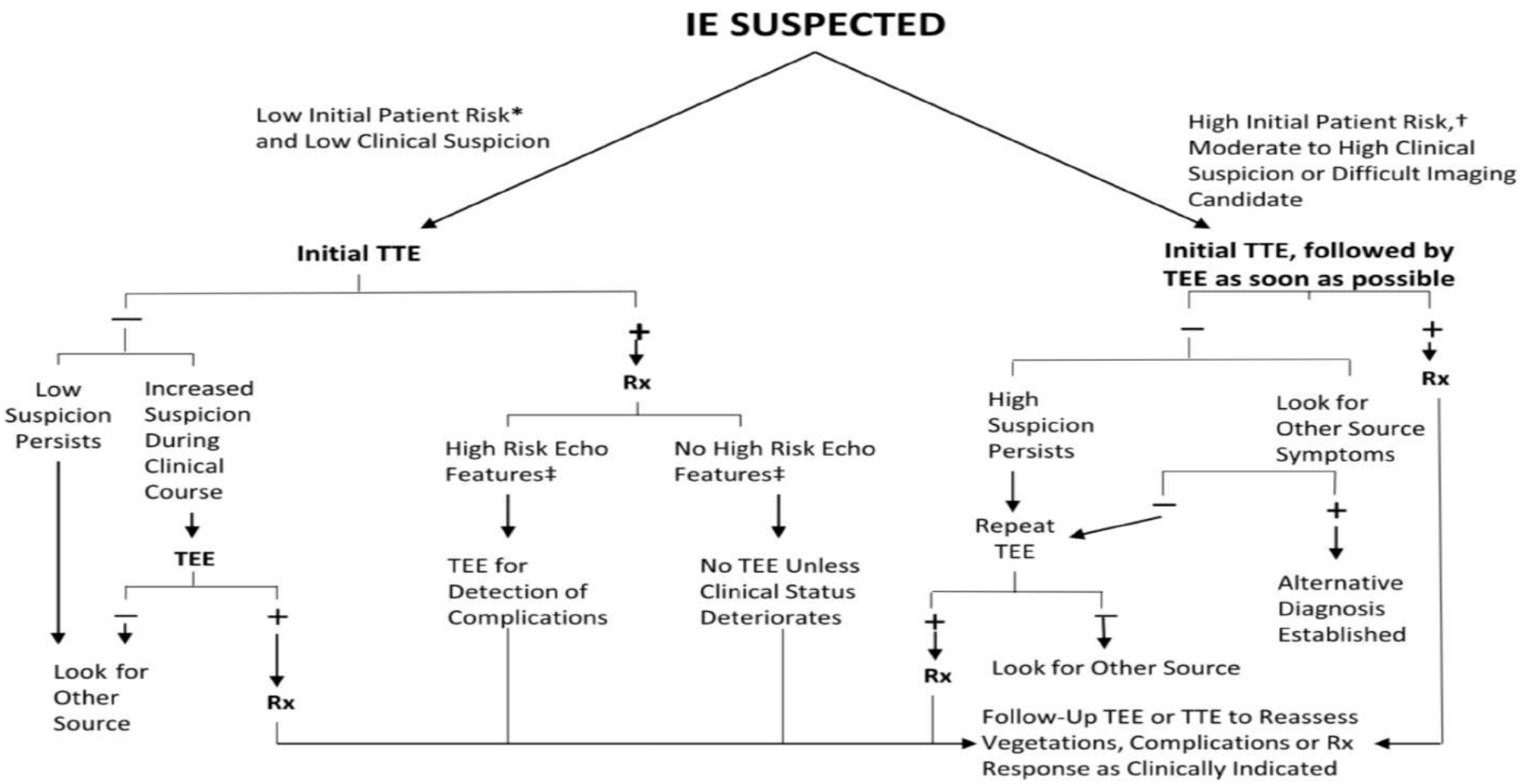
Modified Duke criteria for diagnosis of infective endocarditis - Table B

Major criteria
Positive blood cultures for IE (one of the following):
Typical microorganisms consistent with IE from two separate blood cultures:
Staphylococcus aureus
Viridans streptococci
Streptococcus gallolyticus (formerly *S. bovis*), including nutritional variant strains (*Granulicatella* spp and *Abiotrophia defectiva*)
HACEK group: *Haemophilus* spp, *Aggregatibacter* (formerly *Actinobacillus actinomycete comitants*), *Cardiobacterium hominis*, *Eikenella* spp, and *Kingella kingae*
Community-acquired enterococci, in the absence of a primary focus; **OR**
Persistently positive blood culture:
For organisms that are typical causes of IE: At least two positive blood cultures from blood samples drawn >12 hours apart
For organisms that are more commonly skin contaminants: Three or a majority of ≥4 separate blood cultures (with first and last drawn at least one hour apart)
Single positive blood culture for *Coxiella burnetii* or phase I IgG antibody titer >1:800*
Evidence of endocardial involvement (one of the following):
Echocardiogram positive for IE:
Vegetation (oscillating intracardiac mass on a valve or on supporting structures, in the path of regurgitant jets, or on implanted material, in the absence of an alternative anatomic explanation) **OR**
Abscess **OR**
New partial dehiscence of prosthetic valve
New valvular regurgitation
Increase in or change in preexisting murmur not sufficient

Minor criteria
Predisposition: Intravenous drug use or presence of a predisposing heart condition (prosthetic heart valve or a valve lesion associated with significant regurgitation or turbulence of blood flow)
Fever: Temperature ≥38.0°C (100.4°F)
Vascular phenomena: Major arterial emboli, septic pulmonary infarcts, mycotic aneurysm, intracranial hemorrhage, conjunctival hemorrhages, or Janeway lesions
Immunologic phenomena: Glomerulonephritis, Osler nodes, Roth spots, or rheumatoid factor
Microbiologic evidence: Positive blood cultures that do not meet major criteria **OR** serologic evidence of active infection with organism consistent with IE

An approach to the diagnostic use of echo



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Complications

1. Embolic
2. Local spread
3. Metastatic spread of infection
4. Formation of immune complexes

1. Embolic complications

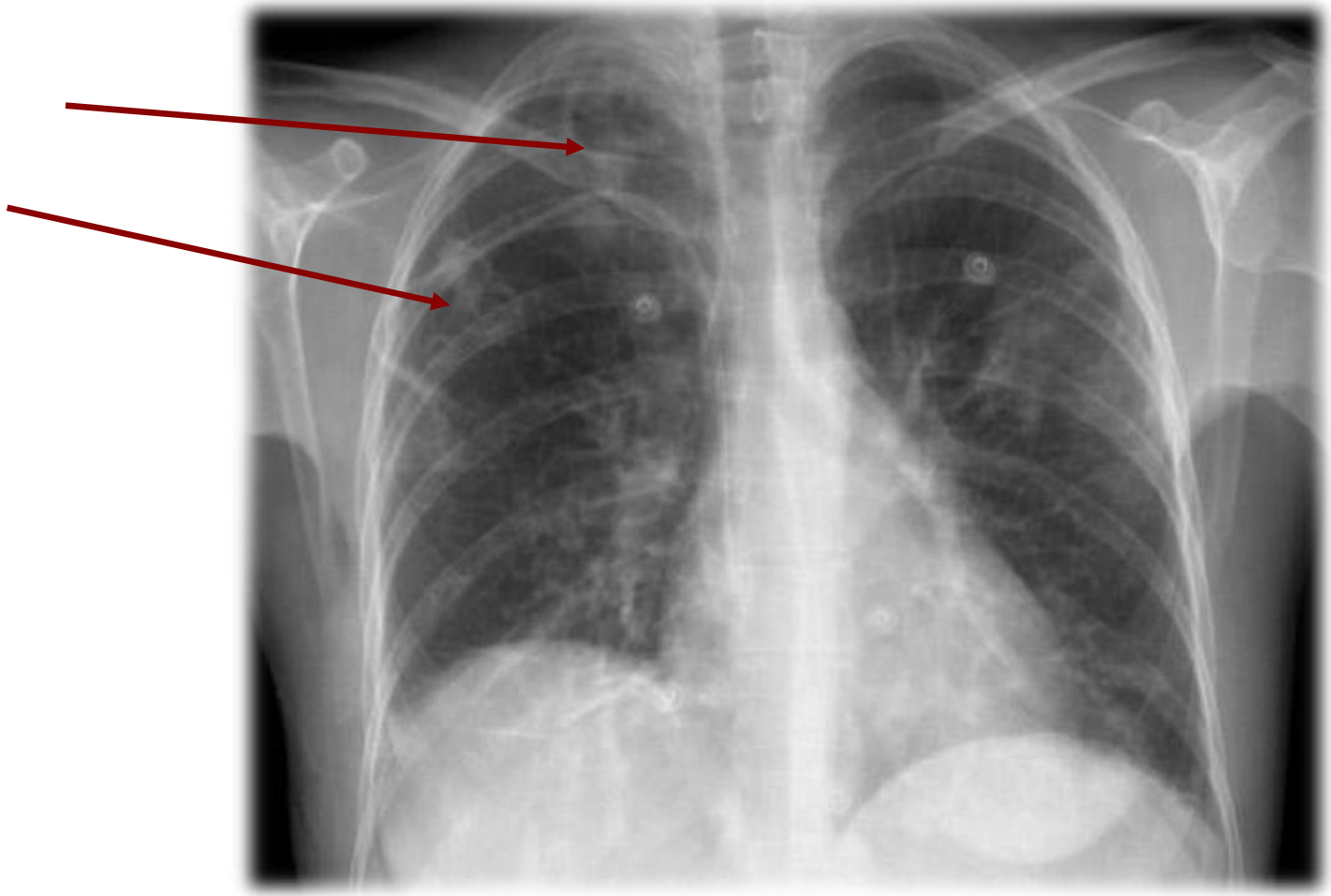
- Stroke: can either be embolic or due to ICH from a ruptured mycotic aneurysm or hemorrhagic transformation of stroke.
- MI
- Ischemic limb
- PE
- Splenic or renal infarction
- Digital infarcts
- Mesenteric ischemia

Uncommon after 2 weeks of effective treatment

Risk Factors:

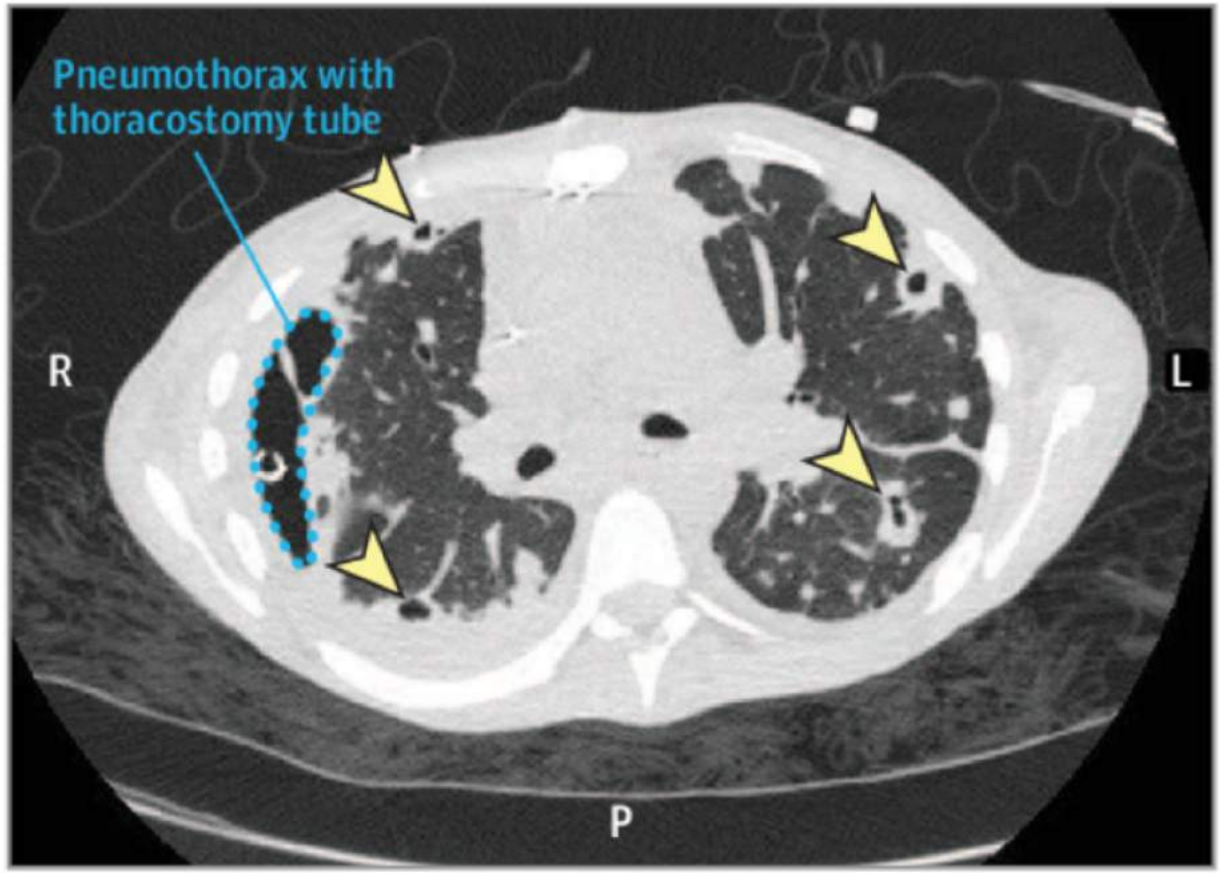
- ✓ Size of vegetation (>10mm)
- ✓ Left side vegetations
- ✓ Staph. aureus
- ✓ Fungal pathogens

Septic Emboli

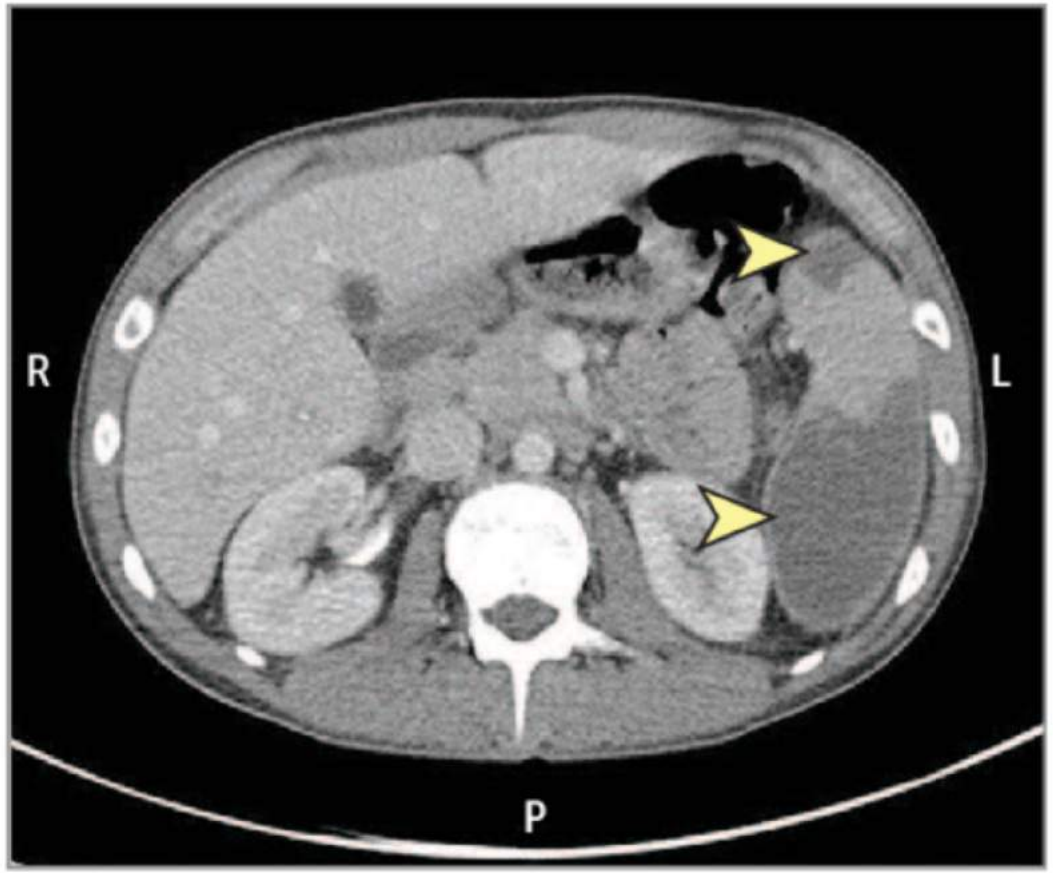


Septic Emboli

A Pulmonary cavitation



B Splenic infarct



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2. Local spread

Heart failure:

- Extensive valvular destruction, ruptured chordae tendinea, fistulas, valve obstruction.

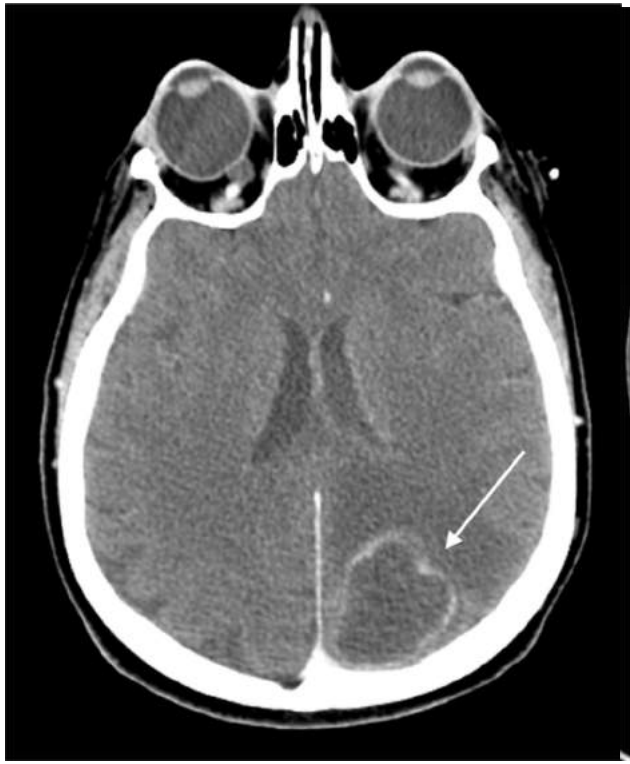
Paravalvular abscess:

- Most common in Aortic valve, IVDA, staph. Aureus
- AV block/conduction disorders

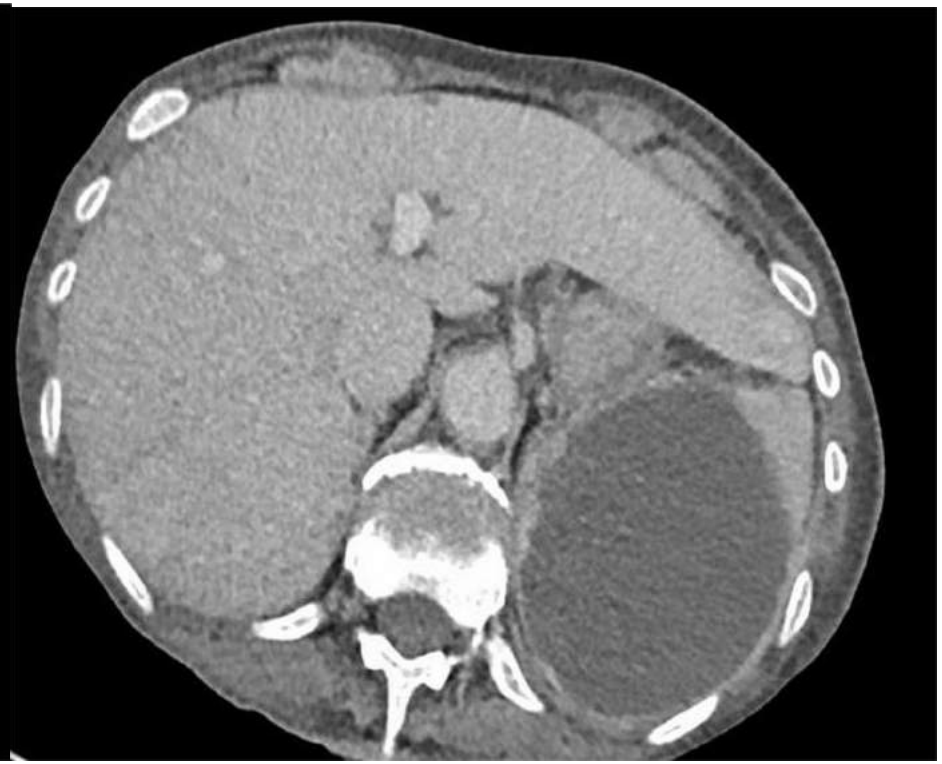
Pericarditis

3. Metastatic spread

- Meningitis
- Vertebral osteomyelitis
- Metastatic abscesses
- Septic arthritis



Brain abscess



Splenic abscess

4. Formation of immune complexes

- Immune complex glomerunephritis leading to ARF
- Arthritis

Investigations

Echocardiography:

- TTE: sensitivity 70%
- TEE: sensitivity 96%, especially with prosthetic endocarditis, intracardiac devices or complications.

Blood cultures:

- Key diagnostic investigation.
- At least 3 sets of samples taken from different venipuncture sites over 24h under a meticulous aseptic technique.

Investigations

- CBC (anemia, leukocytosis)
- U/E (Glomerulonephritis)
- LFT
- Coagulation panel.
- Inflammatory markers (CRP, ESR), CRP can help in monitoring response to therapy
- Urinalysis (proteinuria/ hematuria).
- Serology for culture negative IE (organisms that don’t grow in cultures e.g Coxiella, Legionella, Bartonella).

Investigations

- Investigations that will aid in detecting complications:
  - ✓ ECG
  - ✓ CXR
  - ✓ CT brain
  - ✓ MRI

Management

Antimicrobial Therapy:

- Requires identification of specific pathogen & its susceptibility to antimicrobials.
- Prolonged administration of intravenous antibiotics remains the mainstay of treatment for IE.
- Empirical therapy should be started as soon as possible targeting the most likely pathogen.
- Bactericidal drugs should be used.
- Resolution of fever occurs in 5-7 days (persistence of fever indicates possible complication e.g abscess, embolization etc), drug reaction
- ID consult

Therapy of NVE Caused by Highly Penicillin-Susceptible VGS & *Streptococcus gallolyticus (bovis)*

Regimen	Dose* and Route	Duration, wk	Strength of Recommendation	Comments
Aqueous crystalline penicillin G sodium	12–18 million U/24 h IV either continuously or in 4 or 6 equally divided doses	4	*Class IIa; Level of Evidence B*	Preferred in most patients >65 y or patients with impairment of eighth cranial nerve function or renal function.
Or				Ampicillin 2 g IV every 4 h is a reasonable alternative to penicillin if a penicillin shortage exists.
Ceftriaxone sodium	2 g/24 h IV/IM in 1 dose	4	*Class IIa; Level of Evidence B*	
Aqueous crystalline penicillin G sodium	12–18 million U/24 h IV either continuously or in 6 equally divided doses	2	*Class IIa; Level of Evidence B*	2-wk regimen not intended for patients with known cardiac or extracardiac abscess or for those with creatinine clearance of <20 mL/min, impaired eighth cranial nerve function, or *Abiotrophia, Granulicatella*, or *Gemella* spp infection; gentamicin dose should be adjusted to achieve peak serum concentration of 3–4 µg/mL and trough serum concentration of <1 µg/mL when 3 divided doses are used; there are no optimal drug concentrations for single daily dosing.†
Or				
Ceftriaxone sodium	2 g/24 h IV or IM in 1 dose	2	*Class IIa; Level of Evidence B*	
Plus				
Gentamicin sulfate‡	3 mg/kg per 24 h IV or IM in 1 dose	2		
Vancomycin hydrochloride§	30 mg/kg per 24 h IV in 2 equally divided doses	4	*Class IIa; Level of Evidence B*	Vancomycin therapy is reasonable only for patients unable to tolerate penicillin or ceftriaxone; vancomycin dose should be adjusted to a trough concentration range of 10–15 µg/mL.

Therapy for NVE Caused by Staphylococci

Regimen	Dose* and Route	Duration, wk	Strength of Recommendation	Comments
Oxacillin-susceptible strains				
Nafcillin or oxacillin	12 g/24 h IV in 4–6 equally divided doses	6	*Class I; Level of Evidence C*	For complicated right-sided IE and for left-sided IE; for uncomplicated right-sided IE, 2 wk (see text).
For penicillin-allergic (nonanaphylactoid type) patients				Consider skin testing for oxacillin-susceptible staphylococci and questionable history of immediate-type hypersensitivity to penicillin.
Cefazolin*	6 g/24 h IV in 3 equally divided doses	6	*Class I; Level of Evidence B*	Cephalosporins should be avoided in patients with anaphylactoid-type hypersensitivity to β-lactams; vancomycin should be used in these cases.
Oxacillin-resistant strains				
Vancomycin§	30 mg/kg per 24 h IV in 2 equally divided doses	6	*Class I; Level of Evidence C*	Adjust vancomycin dose to achieve trough concentration of 10–20 μg/mL (see text for vancomycin alternatives).
Daptomycin	≥8 mg/kg/dose	6	*Class IIb; Level of Evidence B*	Await additional study data to define optimal dosing.

Therapy IE Involving a Prosthetic Valve or Other Prosthetic Material Caused by & *Streptococcus gallolyticus (bovis)*

Regimen	Dose* and Route	Duration, wk	Strength of Recommendation	Comments
Penicillin-susceptible strain (≤0.12 μg/mL)				
Aqueous crystalline penicillin G sodium	24 million U/24 h IV either continuously or in 4–6 equally divided doses	6	*Class IIa; Level of Evidence B*	Penicillin or ceftriaxone together with gentamicin has not demonstrated superior cure rates compared with monotherapy with penicillin or ceftriaxone for patients with highly susceptible strain; gentamicin therapy should not be administered to patients with creatinine clearance <30 mL/min.
Or				
Ceftriaxone	2 g/24 h IV or IM in 1 dose	6	*Class IIa; Level of Evidence B*	
With or without				
Gentamicin sulfate†	3 mg/kg per 24 h IV or IM in 1 dose	2		Ampicillin 2 g IV every 4 h is a reasonable alternative to penicillin if a penicillin shortage exists.
Vancomycin hydrochloride‡	30 mg/kg per 24 h IV in 2 equally divided doses	6	*Class IIa; Level of Evidence B*	Vancomycin is reasonable only for patients unable to tolerate penicillin or ceftriaxone.
Penicillin relatively or fully resistant strain (MIC >0.12 μg/mL)				
Aqueous crystalline penicillin sodium	24 million U/24 h IV either continuously or in 4–6 equally divided doses	6	*Class IIa; Level of Evidence B*	Ampicillin 2 g IV every 4 h is a reasonable alternative to penicillin if a penicillin shortage exists.
Or				
Ceftriaxone	2 g/24 h IV/IM in 1 dose	6	*Class IIa; Level of Evidence B*	
Plus				
Gentamicin sulfate	3 mg/kg per 24 h IV/IM in 1 dose	6		
Vancomycin hydrochloride	30 mg/kg per 24 h IV in 2 equally divided doses	6	*Class IIa; Level of Evidence B*	Vancomycin is reasonable only for patients unable to tolerate penicillin or ceftriaxone.

Therapy of IE Involving a Prosthetic Valve or Other Prosthetic Material Caused by Staphylococci

Regimen	Dose* and Route	Duration, wk	Strength of Recommendation	Comments
Penicillin-susceptible strain (≤0.12 μg/mL)				
Aqueous crystalline penicillin G sodium	24 million U/24 h IV either continuously or in 4–6 equally divided doses	6	*Class IIa; Level of Evidence B*	Penicillin or ceftriaxone together with gentamicin has not demonstrated superior cure rates compared with monotherapy with penicillin or ceftriaxone for patients with highly susceptible strain; gentamicin therapy should not be administered to patients with creatinine clearance <30 mL/min.
Or				
Ceftriaxone	2 g/24 h IV or IM in 1 dose	6	*Class IIa; Level of Evidence B*	
With or without				
Gentamicin sulfate†	3 mg/kg per 24 h IV or IM in 1 dose	2		Ampicillin 2 g IV every 4 h is a reasonable alternative to penicillin if a penicillin shortage exists.
Vancomycin hydrochloride‡	30 mg/kg per 24 h IV in 2 equally divided doses	6	*Class IIa; Level of Evidence B*	Vancomycin is reasonable only for patients unable to tolerate penicillin or ceftriaxone.
Penicillin relatively or fully resistant strain (MIC >0.12 μg/mL)				
Aqueous crystalline penicillin sodium	24 million U/24 h IV either continuously or in 4–6 equally divided doses	6	*Class IIa; Level of Evidence B*	Ampicillin 2 g IV every 4 h is a reasonable alternative to penicillin if a penicillin shortage exists.
Or				
Ceftriaxone	2 g/24 h IV/IM in 1 dose	6	*Class IIa; Level of Evidence B*	
Plus				
Gentamicin sulfate	3 mg/kg per 24 h IV/IM in 1 dose	6		
Vancomycin hydrochloride	30 mg/kg per 24 h IV in 2 equally divided doses	6	*Class IIa; Level of Evidence B*	Vancomycin is reasonable only for patients unable to tolerate penicillin or ceftriaxone.

Persistence of fever

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

Indications of Early surgery with native valve IE

- Valve dysfunction resulting in symptoms or signs of heart failure.
- IE caused by fungi or highly resistant organisms.
- IE complicated by heart block, annular abscess, or destructive perforating lesions.
- Persistent infection (bacteremia or fever) lasting >5-7 days after the start of appropriate antimicrobial therapy, assuming other sources of infection or fever have been excluded.
- Recurrent emboli or persistent/enlarging vegetations despite appropriate antimicrobial therapy.

Indications of Early surgery with prosthetic valve IE

1. Symptoms or signs of heart failure resulting from valve dehiscence, intracardiac fistula, or severe prosthetic dysfunction.

2. Persistent bacteremia >5-7 days after the start of appropriate antimicrobial therapy.

3. Prosthetic valve IE complicated by heart block, annular abscess, or destructive perforating lesions.

4. Prosthetic valve IE caused by fungi or highly resistant organisms.

5. Recurrent emboli despite appropriate antimicrobial therapy.

Prophylaxis

Cardiac Conditions Associated With the Highest Risk of Adverse Outcome From Endocarditis for Which Prophylaxis With Dental Procedures Is Reasonable

Prosthetic cardiac valve or prosthetic material used for cardiac valve repair
Previous IE
Congenital heart disease (CHD)*
Unrepaired cyanotic CHD, including palliative shunts and conduits
Completely repaired congenital heart defect with prosthetic material or device, whether placed by surgery or by catheter intervention, during the first 6 months after the procedure†
Repaired CHD with residual defects at the site or adjacent to the site of a prosthetic patch or prosthetic device (which inhibit endothelialization)
Cardiac transplantation recipients who develop cardiac valvulopathy

*Except for the conditions listed above, antibiotic prophylaxis is no longer recommended for any other form of CHD.

†Prophylaxis is reasonable because endothelialization of prosthetic material occurs within 6 months after the procedure.

Dental Procedures for Which Endocarditis Prophylaxis Is Reasonable

All dental procedures that involve manipulation of gingival tissue or the periapical region of teeth or perforation of the oral mucosa*

*The following procedures and events do not need prophylaxis: routine anesthetic injections through noninfected tissue, taking dental radiographs, placement of removable prosthodontic or orthodontic appliances, adjustment of orthodontic appliances, placement of orthodontic brackets, shedding of deciduous teeth, and bleeding from trauma to the lips or oral mucosa.

Regimens for a Dental Procedure

Situation	Agent	Regimen: Single Dose 30 to 60 min Before Procedure	
		Adults	Children
Oral	Amoxicillin	2 g	50 mg/kg
Unable to take oral medication	Ampicillin	2 g IM or IV	50 mg/kg IM or IV
	OR		
	Cefazolin or ceftriaxone	1 g IM or IV	50 mg/kg IM or IV
Allergic to penicillins or ampicillin—oral	Cephalexin*†	2 g	50 mg/kg
	OR		
	Clindamycin	600 mg	20 mg/kg
	OR		
	Azithromycin or clarithromycin	500 mg	15 mg/kg
Allergic to penicillins or ampicillin and unable to take oral medication	Cefazolin or ceftriaxone†	1 g IM or IV	50 mg/kg IM or IV
	OR		
	Clindamycin	600 mg IM or IV	20 mg/kg IM or IV

IM indicates intramuscular; IV, intravenous.

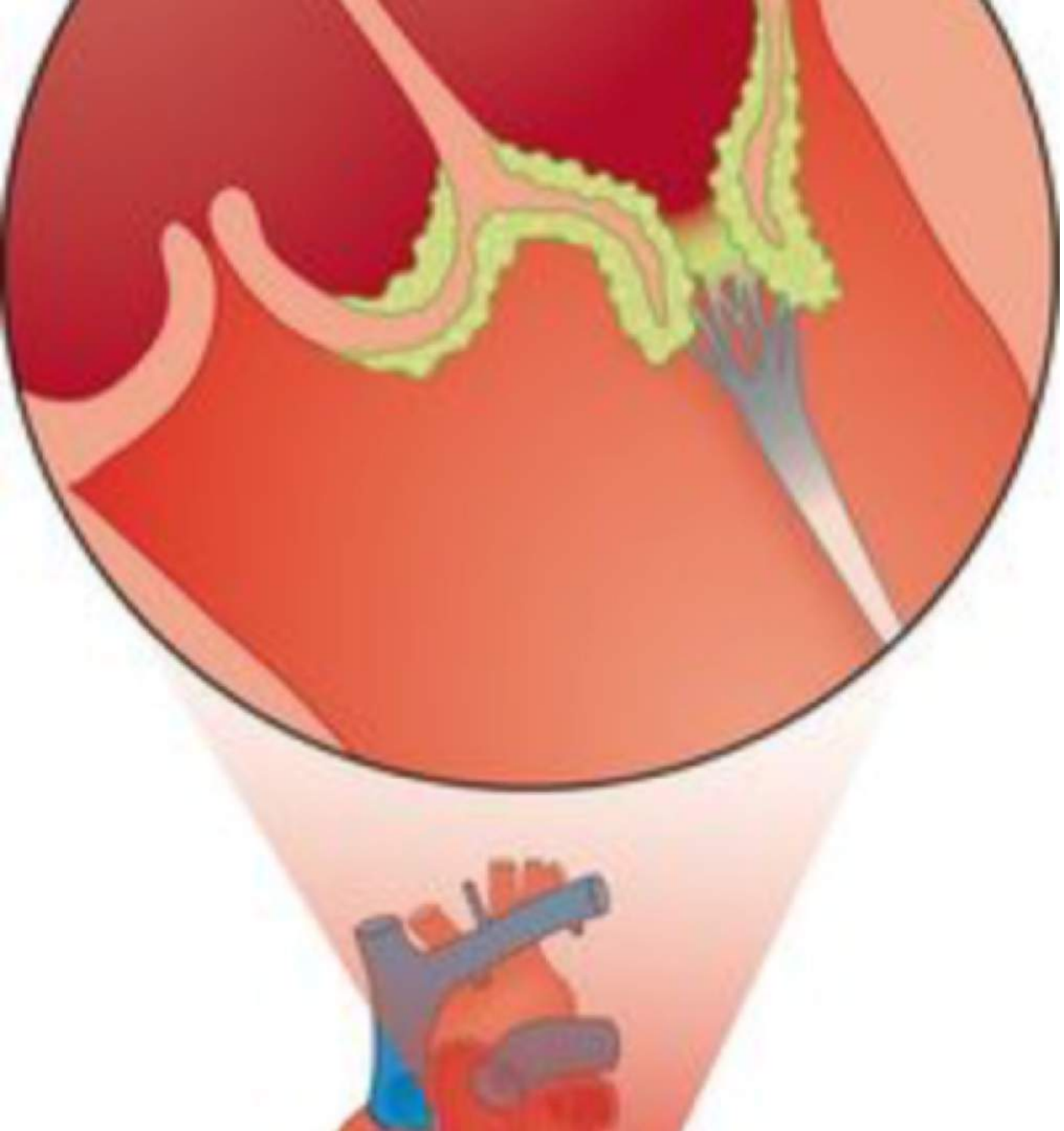
*Or other first- or second-generation oral cephalosporin in equivalent adult or pediatric dosage.

†Cephalosporins should not be used in an individual with a history of anaphylaxis, angioedema, or urticaria with penicillins or ampicillin.

Take home message

Infective endocarditis is a serious disease that requires a high index of clinical suspension and early management.

Recognize the exact pathophysiology, diagnostic criteria, treatment and indications of prophylaxis.



Thank You