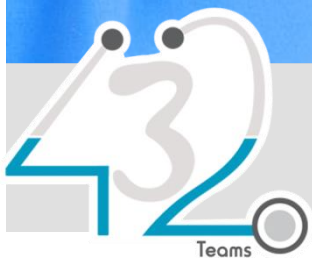


# MEDICINE

432 Team

7

Infective endocarditis



Done By:  
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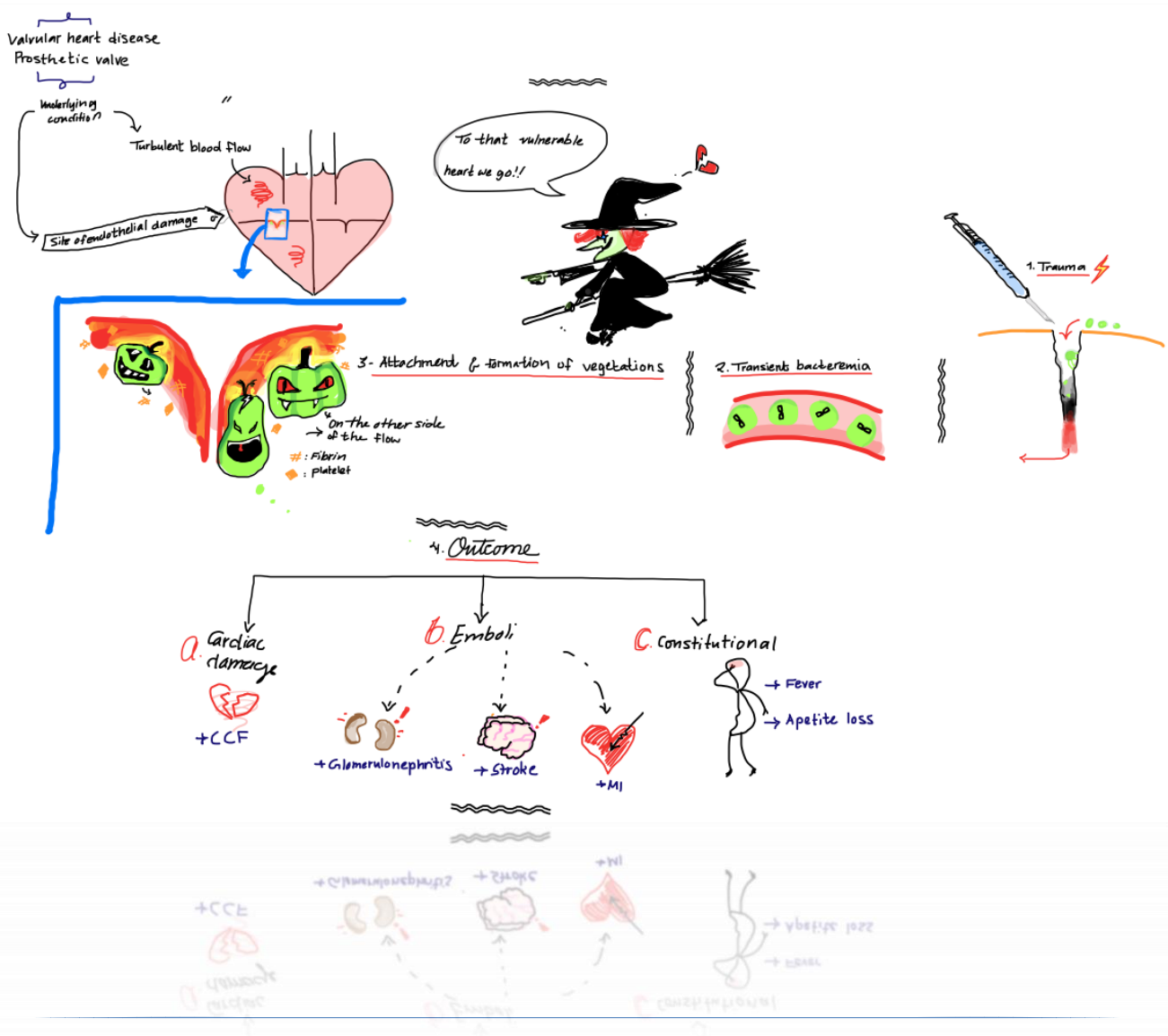
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الملك سعود  
King Saud University



COLOR GUIDE: • Females' Notes • Males' Notes • Important • Additional

# Objectives

1. Definition
2. Pathophysiology
3. Risk factors
4. Clinical features
5. Diagnosis
6. Treatment
7. Complications
8. Prevention



## Definition:

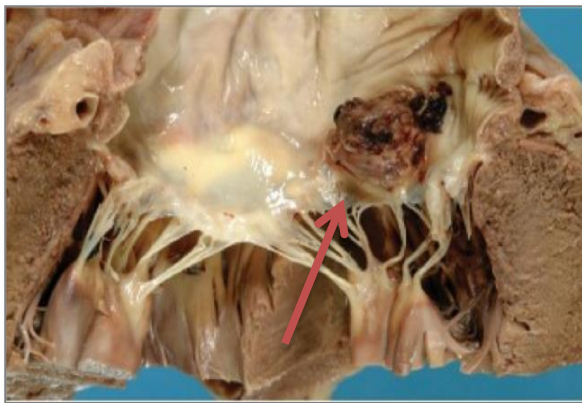
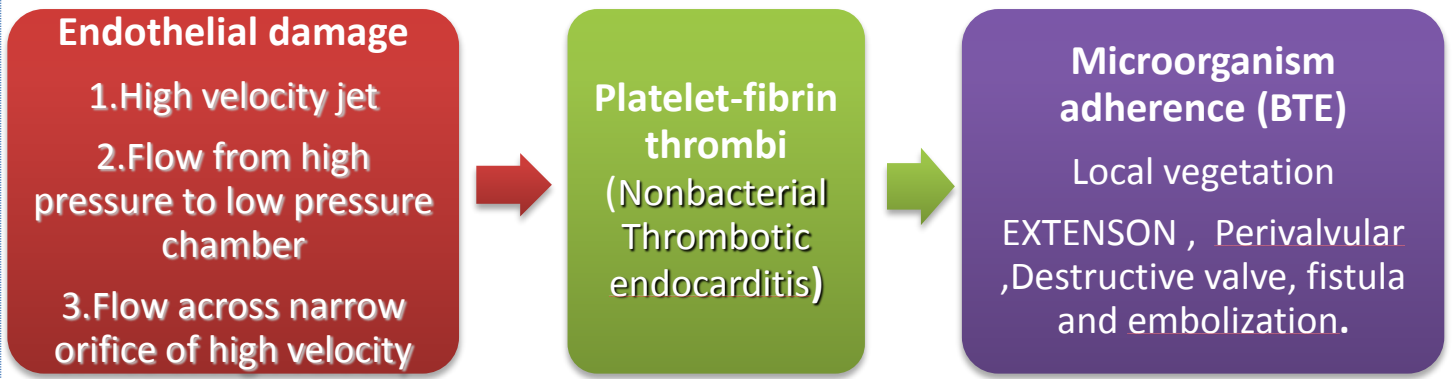
Infection of the **endothelium** of the heart of (valves, septal defects, chordae tendinea, AV shunt). It remains a life threatening disease with a *significant* mortality (about **20%**) and morbidity. *An infection of the endothelial surface that usually involving the cusps of the valves.*

## Pathogenesis:

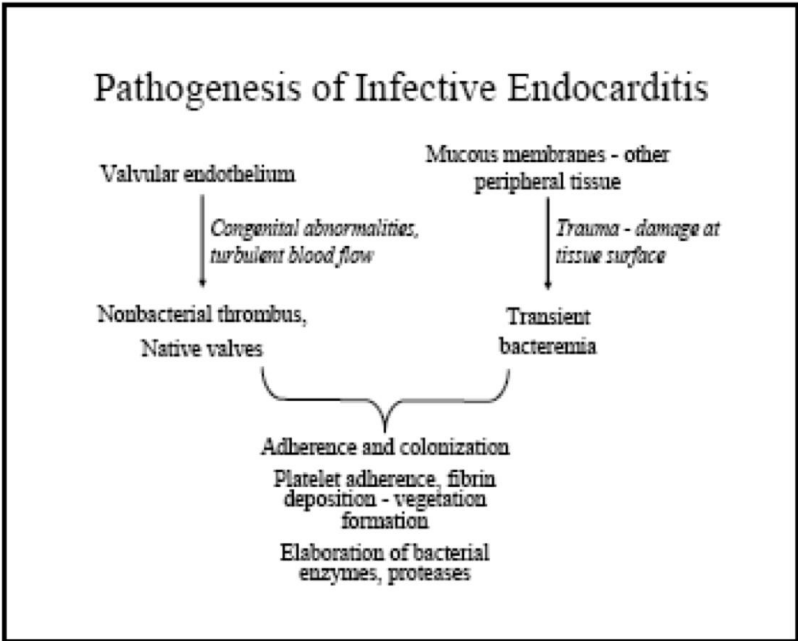
IE is the net result of the complex formation between **bloodstream pathogen** (e.g. *bacteria*) and **endocardia cells damage** which will Attracts matrix molecules and platelets and form **vegetation**

- **Endothelial damage:** **Turbulent blood flow** produced by certain types of congenital or acquired heart disease, such as flow from a high- to a low-pressure chamber or across a narrowed orifice, traumatizes the endothelium.
- **Formation of NBTE (nonbacterial thrombotic endocarditis):** Endothelial damage creates a predisposition for **deposition of platelets and fibrin** on the surface of the endothelium, which results NBTE.
- **Bacteremia:** Invasion of the bloodstream with a **microbial species** that has the pathogenic potential to **colonize** this site then result in **Proliferation** of **bacteria** within a **vegetation** and form **IE**. *They attach at the side with the lower pressure. See page 2.*
- **Trauma to a mucosal surface:** Mucosal surfaces are populated by a dense endogenous microflora.
  - **Gingiva** around the teeth (*strep viridans*)
  - Oropharynx
  - GI tract
  - Urethra/**Vagina** (*E.coli*)

This will releases many different microbial species transiently into the bloodstream which will leads to **transient bacteremia** caused by organism e,g *viridans* group streptococci.



**Vegetations seen in IE**



**Cardiac conditions that make adults and children at risk of IE:**

- Acquired **valvular heart disease** with stenosis or regurgitation
- Valve replacement
- Congenital heart disease
- Hypertrophic cardio-myopathy
- Previous infective endocarditis
- **IV drug abuser.** (Most common in the west)

## Determining risks:

### I. Cardiac condition

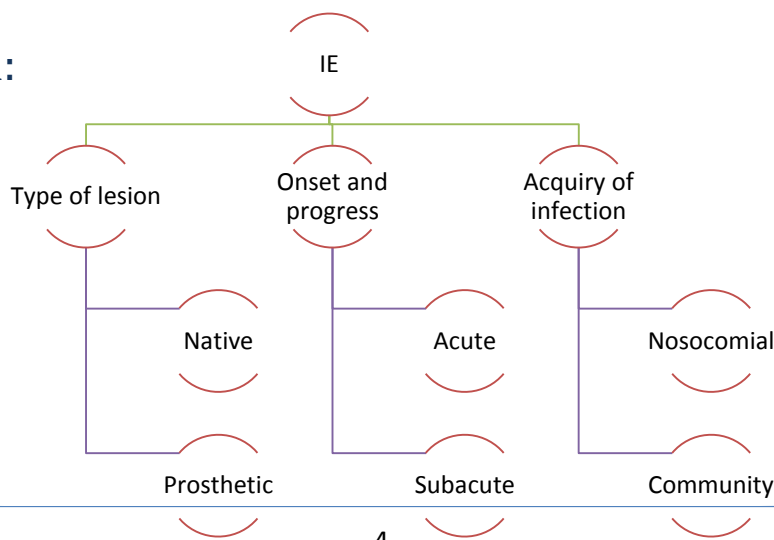
### II. Type of procedure

(I) Cardiac conditions		
High risk	MODERATE risk	NEGLIGIBLE risk
<ul style="list-style-type: none"> <li>• <b>Prosthetic valves</b> (x400 risk)</li> <li>• Previous endocarditis</li> <li>• Congenital:                             <ul style="list-style-type: none"> <li>○ Complex cyanotic disease</li> <li>○ PDA</li> <li>○ VSD</li> <li>○ Coarctation of aorta</li> </ul> </li> <li>• Valvular:                             <ul style="list-style-type: none"> <li>○ <b>AS/AR</b></li> <li>○ MR</li> <li>○ MS with MR</li> </ul> </li> <li>• Surgically constructed systemic pulmonary shunts or conduits.</li> </ul>	<ul style="list-style-type: none"> <li>• Valvular                             <ul style="list-style-type: none"> <li>– MVP + R and/or thickened leaflets</li> <li>– Pure MS</li> <li>– TR/TS</li> <li>– Pulmonary Stenosis</li> <li>– Bicuspid AV/ Aortic Sclerosis</li> <li>– Degenerative valve disease in elderly</li> </ul> </li> <li>• Asymmetrical Septal Hypertrophy/HOCM</li> <li>• Surgically repaired intra-cardiac lesions without hemodynamic abnormality, &lt; 6 months after surgery.</li> </ul>	<ul style="list-style-type: none"> <li>• MVP no regurgitation</li> <li>• Physiologic/innocent murmur</li> <li>• Pacemaker/ICD</li> <li>• Isolated Secundum ASD</li> <li>• Previous CABG</li> <li>• Surgical repair ASD/VSD/PDA, no residua &gt; 6mons after surgery.</li> </ul>
PROPHYLAXIS	PROPHYLAXIS	NO PROPHYLAXIS

Key: Complex cyanotic disease ((Tetralogy, Transposition, Single Ventricle), PDA (Patent ductus arteriosis), VSD (Ventral septal defect), A (Sortic), S (Stenosis), R (Regurgitation), M (Mitral). MVP (Mitral valve prolapse), T (Tricuspid).

(II) Procedures		
High risk	INTERMEDIATE risk	LOW risk
Oral/dental	Genitourinary/Pulmonary	Gastrointestinal

## Classification:



## ORIGINAL CLASSIFICATION (Prior to Antibiotic era)

### Clinical features:

Onset usually within 2 weeks of infection.

- › **Indolent course:** Fever, malaise, fatigue, night sweats, anorexia, weight loss.
- › **Explosive course (with complications):** CCF, murmur new onset or changing characters, with severe systemic sepsis.

#### **Note: Step Up**

~~~~~  
Always suspect IE in a patient with a new heart murmur and unexplained fever!  
~~~~~

Other:

- Splenomegaly ~ 30%
- Petechiae 20 - 40%

(Conjunctivae/buccal mucosa/palate/skin in supraclavicular regions)

- Osler's Nodes 10 - 25%
- Splinter hemorrhage 5 - 10%
- Roth Spots ~ 5%
- Musculoskeletal (arthritis) / RF +ve

#### **Note: Step Up**

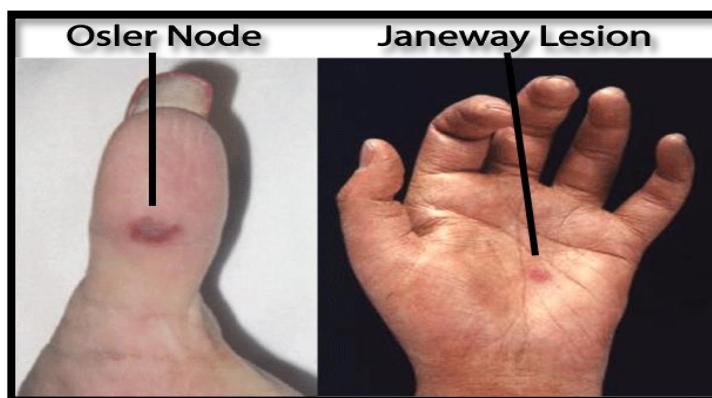
~~~~~  
Roth's spots: oval retinal hemorrhages with a clear pale center.  
~~~~~

Features are best divided according to cause into constitutional, those resulting embolization giving rise to vascular phenomena (Roth's spots), deposition of immunological complexes (Osler's nodes.) They are best remembered by the mnemonic device:

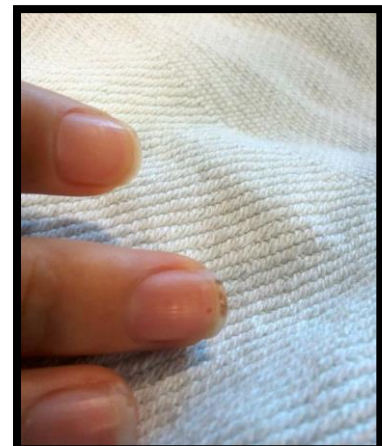
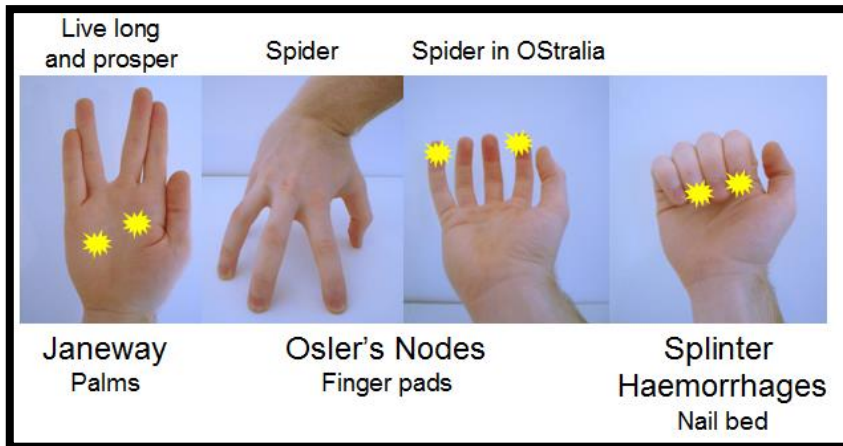
### FROM JANE

Fever, Roth spot, Osler node, Murmur,

Jeneway lesion, Anemia,  
Nails hemorrhage, Embolization

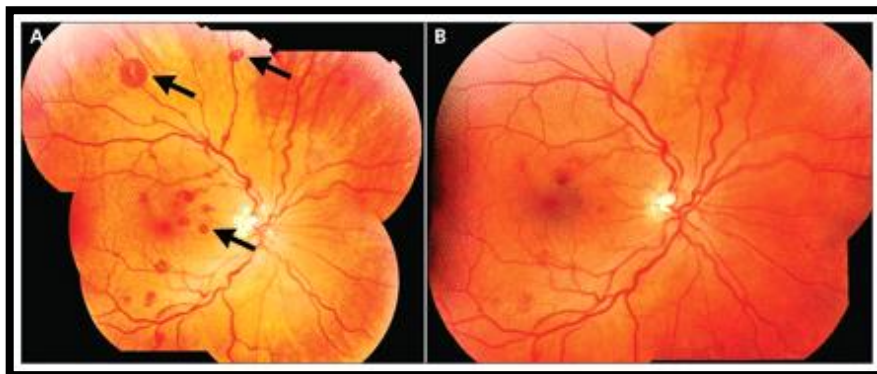


Osler node	Janeway Lesion
Raised, tender nodules caused by deposition of immune complexes.	Flat, non-tender, erythematous nodules on palms and soles caused by septic emboli.

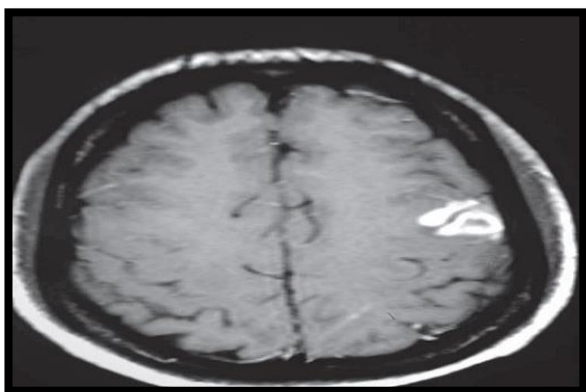


Sites of different nail pathologies seen in IE

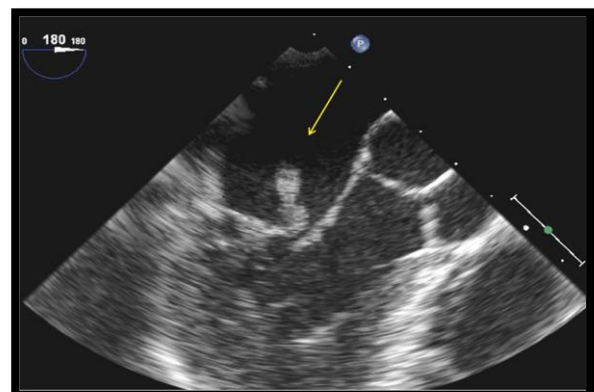
Splinter hemorrhage



Roth's spots (vascular phenomena)



Complications: emboli to the brain



TEE showing vegetation on valve

## Diagnostic tests:

- CBC (normocytic normochromic anemia and leukocytosis)
- ESR (elevated), (CRP more reliable for monitoring progress)
- **Blood cultures** (at least 2 taken from 2 different sites at 2 different times -30 mins apart- in 2 tubes for aerobic and anaerobic)
- RFT (
- URINE (proteinuria and hematuria from glomerulonephritis)
- EKG (AV block due to aortic root abscess/infarction due to emboli)
- CXR (evidence of cardiac failure/ cardiomegaly)
- **ECHO**: single most important diagnostic test.
  - TTE (trans-thoracic echo): can detect vegetations as small as 2-4mm. Sensitivity of ~65%.
  - TEE (trans-esophageal echo): can pick even smaller ones 1-1.5mm. Sensitivity >90%. (you can see the vegetation here very clearly)

*In Echo when you see a vegetation with no infection proof, then think of autoimmune disease e.g., SLE.*

Microbiology of infective endocarditis		
Native valve	In IV drug users	Prosthetic valve
<ul style="list-style-type: none"> <li>➤ <b>Streptococci</b> (50-70%)</li> <li>Of all cases.</li> <li>    – <b>Viridans</b> (50%)</li> <li>Of strep.</li> <li>➤ Staphylococci (25%)</li> <li>➤ Enterococci (10%)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Skin</b> most predominant source of infection</li> <li>• 70 - 100% of Rt. sided IE results in pneumonia and septic emboli.</li> <li>➤ <b>Staph. aureus</b> ~60%</li> <li>➤ Strep/enterococci ~20%</li> <li>➤ Gram -ve bacilli ~10%</li> <li>➤ Fungi (Candida and Aspergillus ~5%)</li> <li>~</li> <li><b>HACEK (difficult to culture)</b></li> <li>Haemophilus species,</li> <li>Actinobacillus</li> <li>Actinomycetemcomitans,</li> <li>Cardiobacterium hominis,</li> <li>Eikenella,</li> <li>Kingella</li> </ul>	<ul style="list-style-type: none"> <li>• Reflects perioperative contamination</li> <li>• Incidence around 1%</li> <li>➤ Staph (45 - 50%)                             <ul style="list-style-type: none"> <li>– Staph. Epiderm (~30%)</li> <li>– Staph. Aureus (~20%)</li> </ul> </li> <li>➤ Gram -ve aerobes (~20%)</li> <li>➤ Fungi (~10%)</li> <li>➤ Strep and Entero (5-10%)</li> </ul>
	<60 days	
	>60 days	<ul style="list-style-type: none"> <li>• After endothelialization</li> <li>• Incidence 0.2 -0.5 % / pt. year</li> <li>• Transient bacteraemia from dental, GI or GU</li> <li>~</li> <li>➤ Agents resemble <b>native valve endocarditis</b>.</li> </ul>

\* Of all cases. \*\* Of strep.



## Modified Duke Criteria:

Clinical criteria for diagnosis: Must fulfill at least

➤ 2 major

➤ 1 major 2 minor

➤ 5 minor

Duke criteria	
Major	Minor
1. Positive <b>Blood cultures</b> <ol style="list-style-type: none"> <li>Typical organisms from 2 separated blood cultures</li> <li>Persist positive blood cultures</li> <li>Positive blood culture for coxella burniti</li> </ol> 2. Evidence of <b>Endocardial involvement</b> <ul style="list-style-type: none"> <li>Positive Echocardiogram                             <ul style="list-style-type: none"> <li>Oscillating intra cardiac mass</li> <li>Abscess</li> <li>Dehiscence of prosthetic valve</li> <li>New Valvular regurgitation</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>&gt; <b>Fever</b> of 100.4°F or higher</li> <li>&gt; <b>Echocardiographic</b> evidence not meeting major criteria</li> <li>&gt; <b>Vascular</b> (Arterial emboli, septic pulmonary infarcts, intracranial hemorrhage, Janeway lesion)</li> <li>&gt; <b>Evidence from microbial</b></li> <li>&gt; <b>Evidence of immunologic</b> phenomena (Osler, Roth spots, Rheumatoid Factor)</li> <li>&gt; <b>Risk factor</b> = Predisposition (heart condition or IV drug use)</li> </ul>

Best remembered by the mnemonic **BE (MAJOR) FEVEER (MINOR)**

### Definitve IE

- **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.
- **Clinical criteria** (as above)

### Possible IE

- findings consistent of IE that fall short of “definite”, but not “rejected”
- IE considered in presence of 1 major + 1 minor or 3 minor

### IE rejected

- Firm alternate Dx 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

## Treatment:

Could either be medical or surgical?

### Principles of medical treatment:

- Sterilization of Vegetations with antibiotics.
- Prolonged, high dose and bactericidal.
  - **Acute onset:**
    - Blood culture and start treatment **within three hours.**
  - **Sub acute onset:**
    - Blood culture then antibiotic can be started **within three days.**

### **Note: Step Up**

*Infective endocarditis is almost always fatal if left untreated.*

### Indications for surgery:

- Valvular disruption leading to severe insufficiency and CCF
- Extra valvular extension
- Embolization of vegetations
- Failure of medical management
  - Positive blood culture and systemic signs of infection after “adequate” antibiotic therapy
- Resistant organisms such as MRSA, Fungi , Pseudomonas
- Echo detected vegetation > 1 cm?

## Complications:

### **Congestive cardiac failure:**

- 1) Valvular destruction
- 2) Myocarditis
- 3) Coronary artery embolism and MI
- 4) Myocardial abscesses

### **Neurological manifestations:**

- 1) Major embolism to MCA territory ~25%
- 2) Mycotic Aneurysms 2 - 10%

### **Metastatic:**

- 1) Rt. Sided vegetations
- 2) Lung abscesses
- 3) Pyothorax / Pyo-pneumothorax

### **Lt. Sided vegetations**

- 1) Pyogenic Meningitis
- 2) Splenic Abscesses
- 3) Pyelonephritis
- 4) Osteomyelitis

### **Renal impairment/glomerulonephritis.**

## Prevention:

2gm of penicillin or amoxicillin for high and moderate cardiac risk 2 hours before procedure.

## SUMMARY

### Risk factors

- Cardiac (valvular replacement, valvular problems, Congenital or acquired heart diseases)
- Procedures (Oral, dental, Genitourinary, Pulmonary, gastrointestinal)

### Clinical features

- Infection causing (fever, malaise, anorexia, fatigue, weight loss)
- Embolization of the vegetation (regular or septic emboli which contain abscess that will cause abscess or necrosis to any place it goes to)
- Invasion of the vegetation (valvular and heart problems)
- Immune complex (infective arthritis, Roth spot Osler node, glomerulonephritis)
- Complicated symptoms murmur, severe systemic sepsis

### Investigations

1. CBC (leucocytes high platelets low)
2. ESR high
3. Blood culture
4. CXR
5. ECHO to see the vegetation (TTE 2-4mm, TEE 1-1.5mm)

### Diagnosis

- Dukes criteria

### Prophylaxis

- Before any dental or major surgery to people with high risk (Ampicillin in half an hour before the surgery)

### Treatment

- Antibiotic for 4-6 weeks and should be started in 3 hours of acute IE and 3 days of sub-acute
- Surgery in case of complication e.g. heart failure

## Bacterial Endocarditis

Easy to diagnose and treat -- if you think of it.

It all begins when one bacterium finds a home underneath one platelet.

**Likely starting places:**

- deformed surfaces
- old rheumatic fever
- birth defects
- prosthetic valves
- needle drug abuse

Dentist visit? alpha-strep  
Below the belt? enterococcus  
Druggie? staph or anything

fever  
just don't feel right  
Roth spots

heart attacks  
strokes  
abscesses

new / changing murmurs  
big spleen

petechiae

Osler nodes

Masses of fibrin, neutrophils, and bacteria on a valve.

The location on the endocardium gives the bacteria a strong head start.

## Questions

- 1) Which of the following is considered as a major Duke Criteria?
  - A. Arterial emboli
  - B. Roth spots
  - C. New Valvular regurgitation
  - D. IV drug abuse
  
- 2) Partial cystectomy for squamous cell carcinoma of the bladder considered as?
  - A. High risk procedure for Infective endocarditis
  - B. Intermediate risk procedure for Infective endocarditis
  - C. Low risk procedure for Infective endocarditis
  - D. No relation at all between the procedure and Infective endocarditis
  
- 3) The strongest indication for surgery in IE is:
  - A. Persistence of fever
  - B. Septic embolism
  - C. Congestive cardiac failure
  - D. Perivalvular invasive disease
  
- 4) The composition of vegetation includes:
  - A. Fibrin
  - B. Platelet
  - C. Inflammatory cells
  - D. All of the above
  
- 5) Infective endocarditis in i.v. drug abusers is most commonly caused by:
  - A. staph aureus
  - B. staph epidermis's.
  - C. Coagulase negative staph.
  - D. Streptococcus pneumoniae.

**432 Medicine Team Leaders**

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**Answers:**

1st Questions: **C**

2nd Questions: **B**

3rd Questions: **C**

4th Questions: **D**

5th Questions: **A**