PATHOLOGY

بسم الله الرحمن الرحيم

DOPAMINE SCIENTIFIC TEAM

FINAL | Lecture 8

Valvular Heart Disease

وَلَقَدْ خَلَقْنَا الْإِنسَانَ وَنَعْلَمُ مَا تُوَسْوِسُ بِهِ نَفْسُهُ ۖ وَنَحْنُ أَقْرَبُ إِلَيْهِ مِنْ حَبْلِ الْوَرِيدِ

اللهم إنّا نعوذ بك من شرور أنفسنا ومن سيئات أعمالنا

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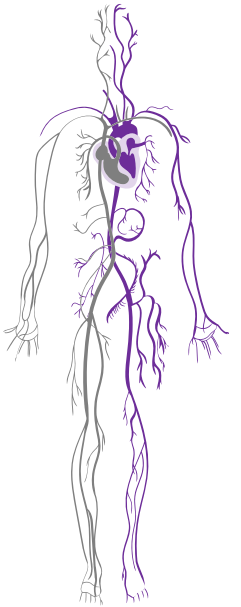
فريق دوبامين العلمي - THE SCIENTIFIC TEAM OF DOPAMINE - APPROVED 0500331



وَلِلَّهِ الْأَسْمَاءُ الْحُسْنَى فَادْعُوهُ بِهَا

المعنى: المحمود في جميع أفعاله وأقواله، وصفاته وأسمائه، وشرعه وقدَرِه، يُحمد على كلّ حال، وهو المستحق للحمد والثناء لكمال صفاته ولكثير إحسانه إلى الخلق.

الورود: ورد في القرآن (١٧) مرة.

الشاهد: ﴿ إِنَّهُۥ حَمِيدٌ مَّجِيدٌ ﴾ [هود:٧٣].

٥١

اضغط هنا لشرحٍ أكثر تفصيلًا

Pathology of Valvular Heart Disease

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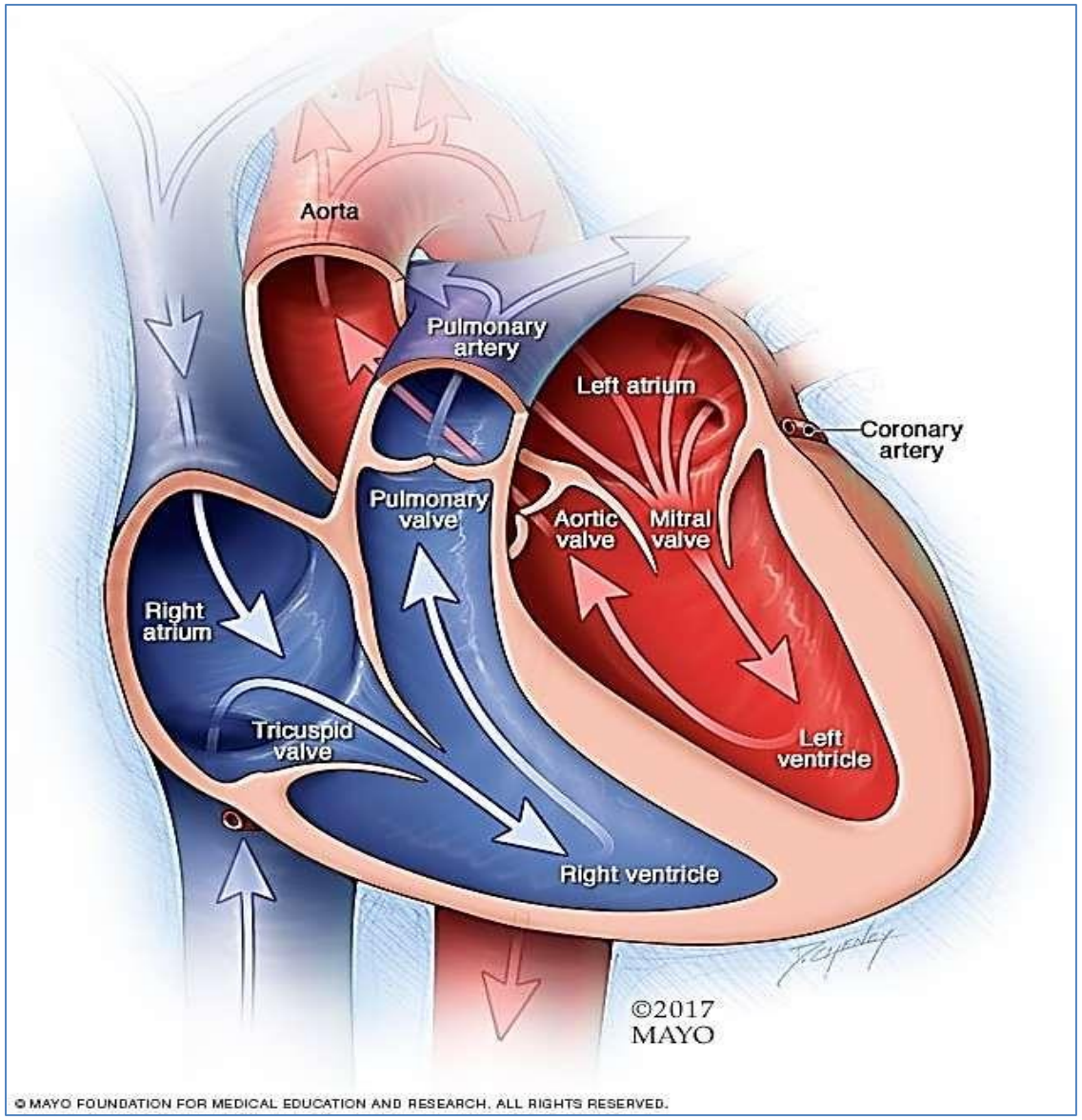
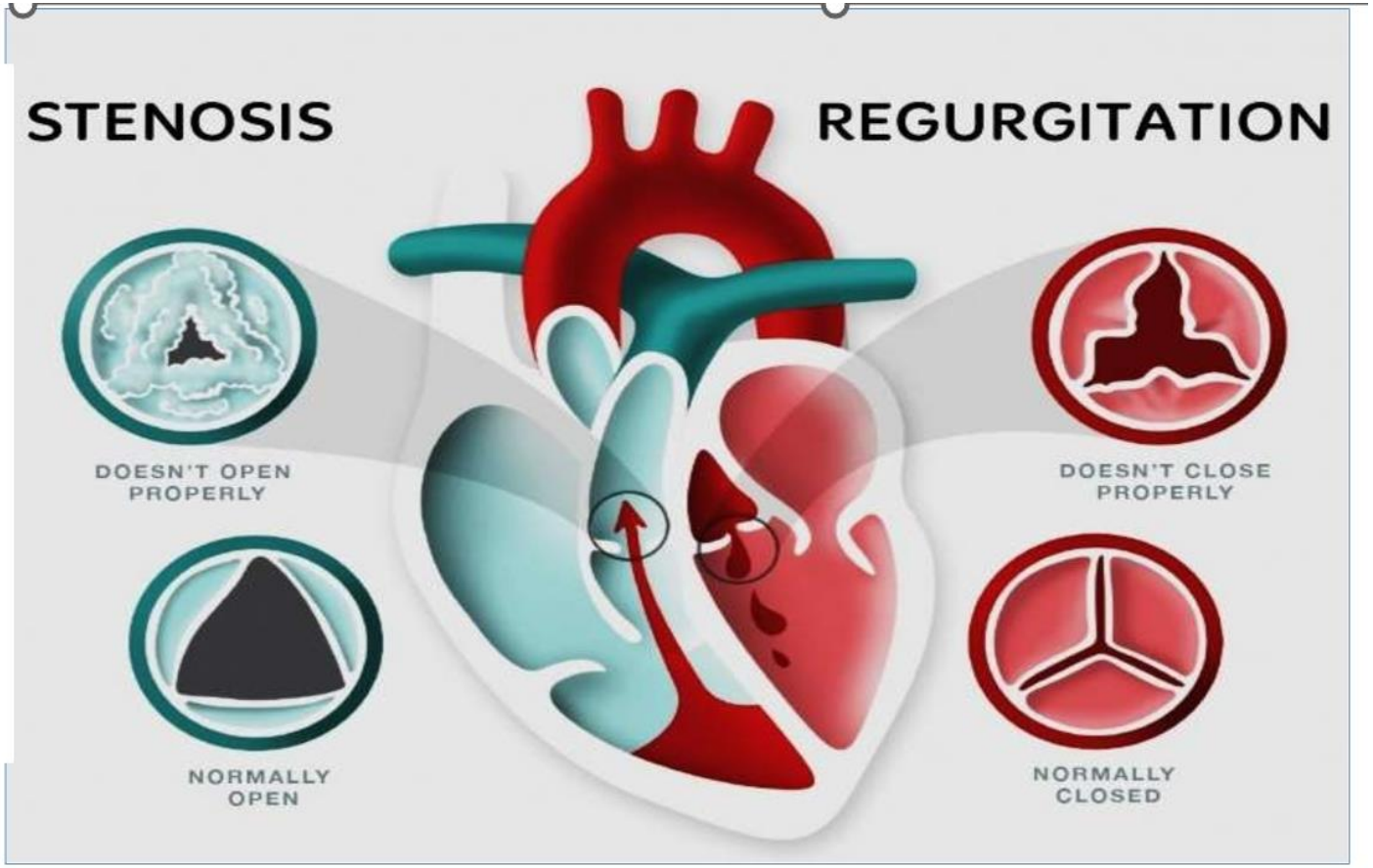
Normal Heart Valves



- The heart has four chambers: the left atrium (LA), the right atrium (RA), the left ventricle (LV), and the right ventricle (RV). The general blood pathway is as follows: **systemic venous circulation → right atrium → right ventricle → pulmonary trunk (artery) → lungs.**
  Lungs → pulmonary veins → left atrium → left ventricle → aorta → systemic circulation (the whole body).
  Knowing these pathways is important **in cases of valve disease,** as it helps us **trace blood flow and predict possible consequences.**

VALVULAR HEART DISEASE



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· Valvular heart pathology involves two major structure–function concepts:

1. Valvular regurgitation (valve inefficiency): the heart valves fail to close properly, creating an abnormal opening that allows backward blood flow, leading to abnormal flow across that valve.

2. Stenosis, which refers to the impaired or incomplete opening of a valve. It usually develops through chronic processes such as calcification or post-inflammatory scarring.

Abnormalities leading to stenosis or regurgitation can involve the valve cusps or their supporting structures (e.g., mitral annulus, tendinous cords, papillary muscles).

These abnormalities may be **acute**, causing sudden regurgitation (e.g., acute chordal rupture, papillary muscle rupture after acute MI), or **chronic**, as in post-inflammatory scarring.

Clinical Signs of Valve Disease

- Abnormal heart sounds (**murmurs**) can be heard using a stethoscope.
- Sometimes, **murmurs** are loud enough to be felt during chest examination, and these palpable vibrations are called **thrills**.
- There are specific clinical signs depending on the valve involved.

Classification of Heart Valve Disorders

- Valvular abnormalities can be **congenital** (caused by a genetic mutation, and the patient is born with a defect in the valve) or acquired (developing during life when a disease or condition leads to an abnormal heart valve).

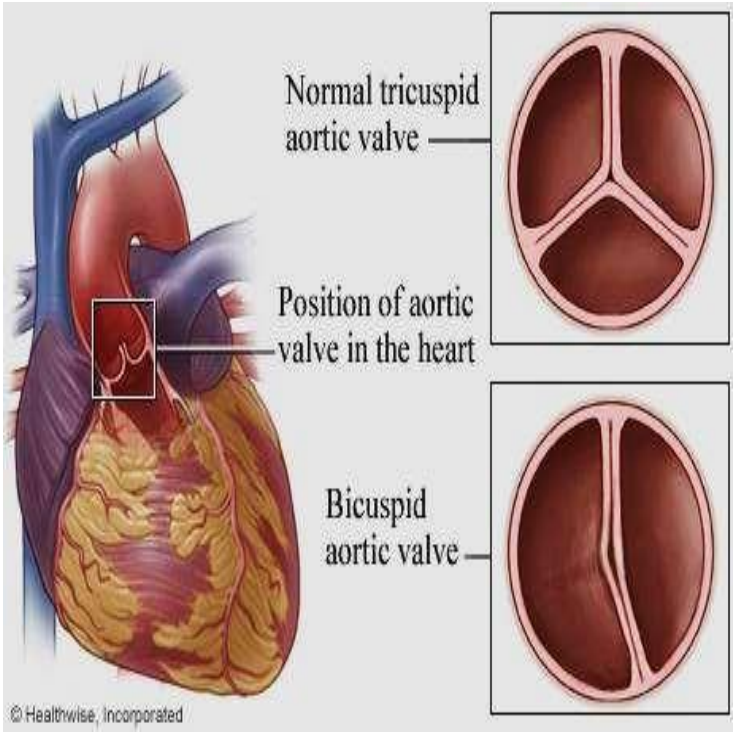
- Congenital heart valve diseases are diverse, but the most common congenital valve lesion is the **bicuspid aortic valve.**

- The most important cause of acquired valve disease is **rheumatic fever.**

- Another example of acquired valve disease is **infective endocarditis.**

Bicuspid Aortic Valve

- Only patients with a bicuspid aortic valve have two functional cusps instead of three, which is an anatomical abnormality.
- Occurs in approximately 1–2% of live births.
- May be isolated or genetically inherited, and sometimes associated with other congenital heart defects or aortopathies.

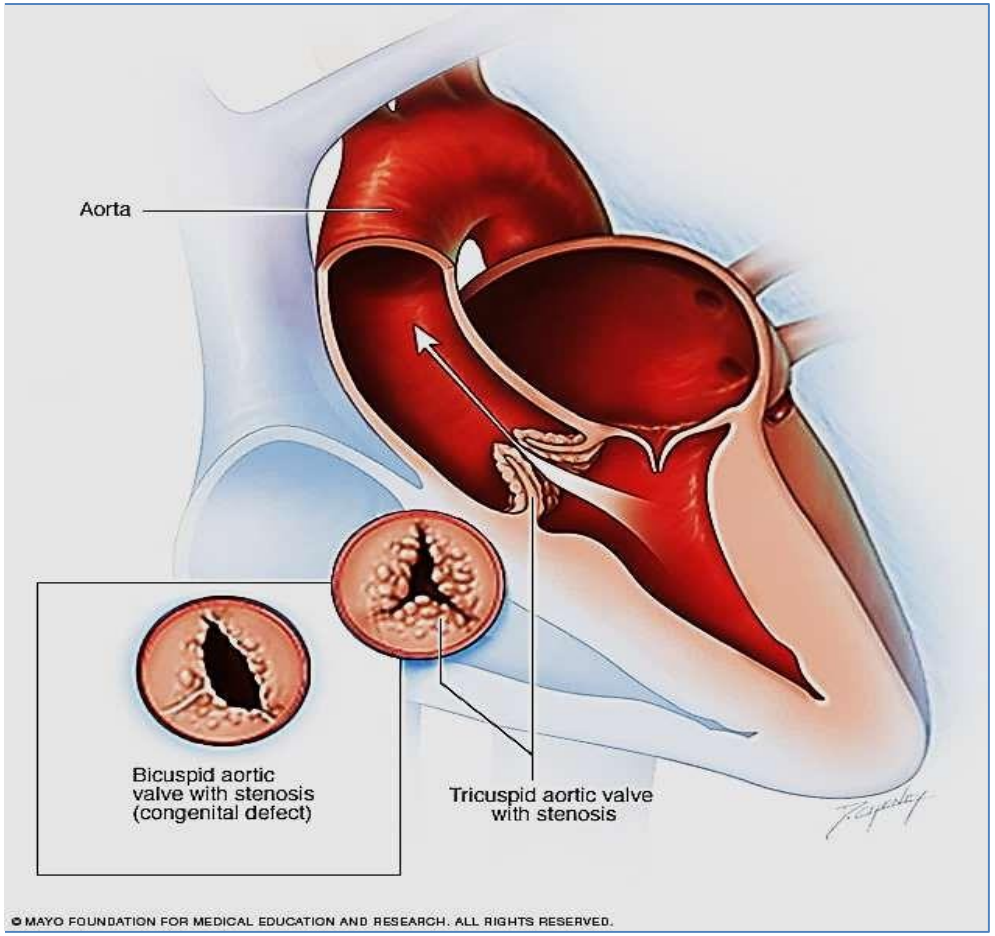


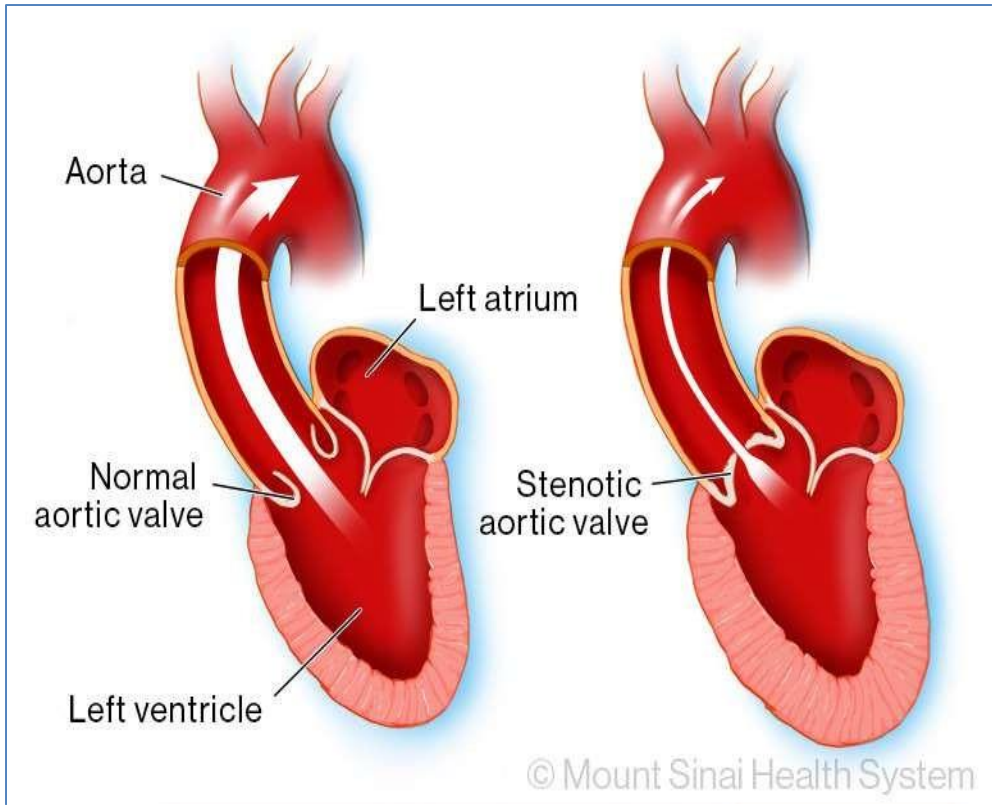
– In early life → Asymptomatic

– Later in life → progressive degenerative calcification of the aortic valve may occur, and some individuals will develop **aortic stenosis**, leading to left **ventricular hypertrophy** and eventually **heart failure**.

- The abnormal load on the bicuspid aortic valve, due to its altered shape, can lead to increased stress on the valve leaflets. This abnormal stress accelerates degenerative calcification compared to a normal tricuspid aortic valve. Over time, this can cause early and progressive valve dysfunction, contributing to the development of **aortic stenosis** and subsequent **left ventricular hypertrophy**.

Aortic Valve Stenosis





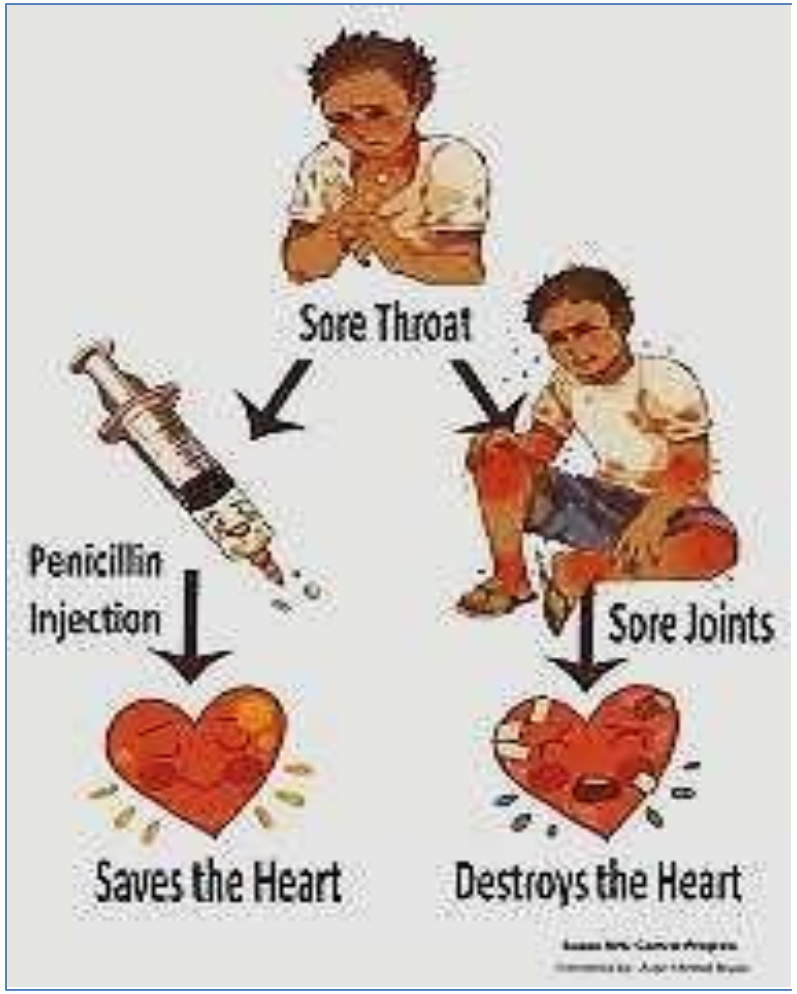
Acquired Valve Diseases

- All four cardiac valves can be affected by acquired valve disease, but **the mitral valve** is exposed to higher pressures and greater shear stress than other valves because it is located on the left side of the heart, making it **the most common target of acquired valvular diseases.**

- The most common cause of acquired valvular disease is **post-inflammatory scarring** due to **rheumatic fever** (≈ two-thirds of cases worldwide).
  The term **"rheumatic" refers to joint involvement,** which explains the clinical features of the disease, such as **joint pain and fever.**

Rheumatic fever
(Rheumatic Valve Disease)

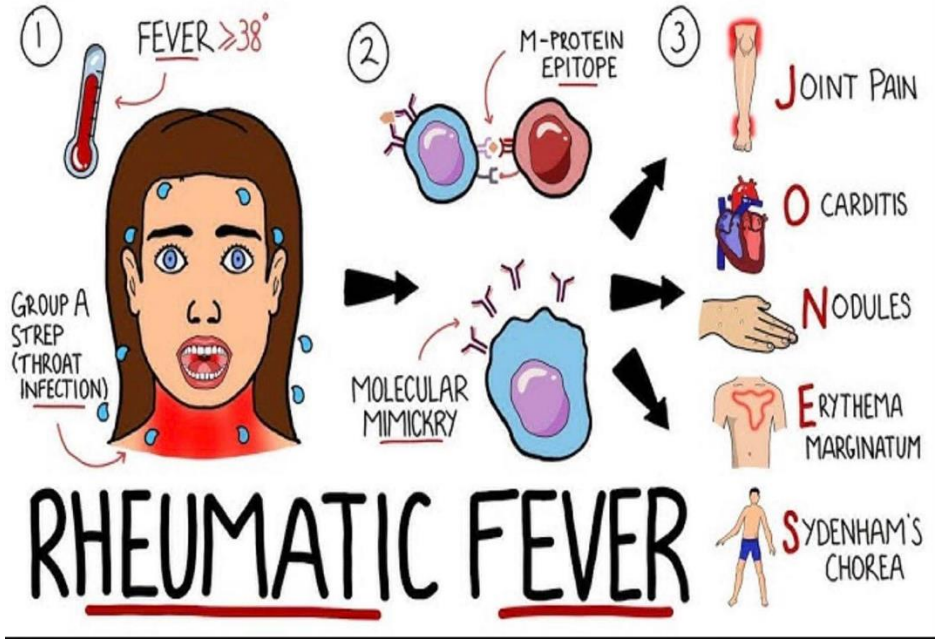
- An immune-mediated inflammatory disease that follows infection with *Group A Streptococcus*, meaning rheumatic fever is not a direct infection of the heart by the bacteria.
- Incidence has decreased in the Western world (due to improved socioeconomic conditions and rapid diagnosis and treatment of streptococcal pharyngitis).
- Still, an important public health problem in developing countries



Further details:

- The population most vulnerable to developing acute pharyngitis is young children. In underdeveloped regions where access to **penicillin therapy** is limited, these children face a significantly higher risk of progressing to acute rheumatic fever due to untreated Group A streptococcal infection, which can lead to carditis and migratory polyarthritis.

- In the case of Streptococcus pyogenes (Group A Streptococcus) infection, particularly when a child does not receive timely and adequate antibiotic therapy, the immune system mounts a normal response that, with prolonged infection, allows for the generation of antibodies that can cross-react with host tissues due to molecular mimicry. These cross-reactive antibodies contribute to the pathogenesis of acute rheumatic fever.



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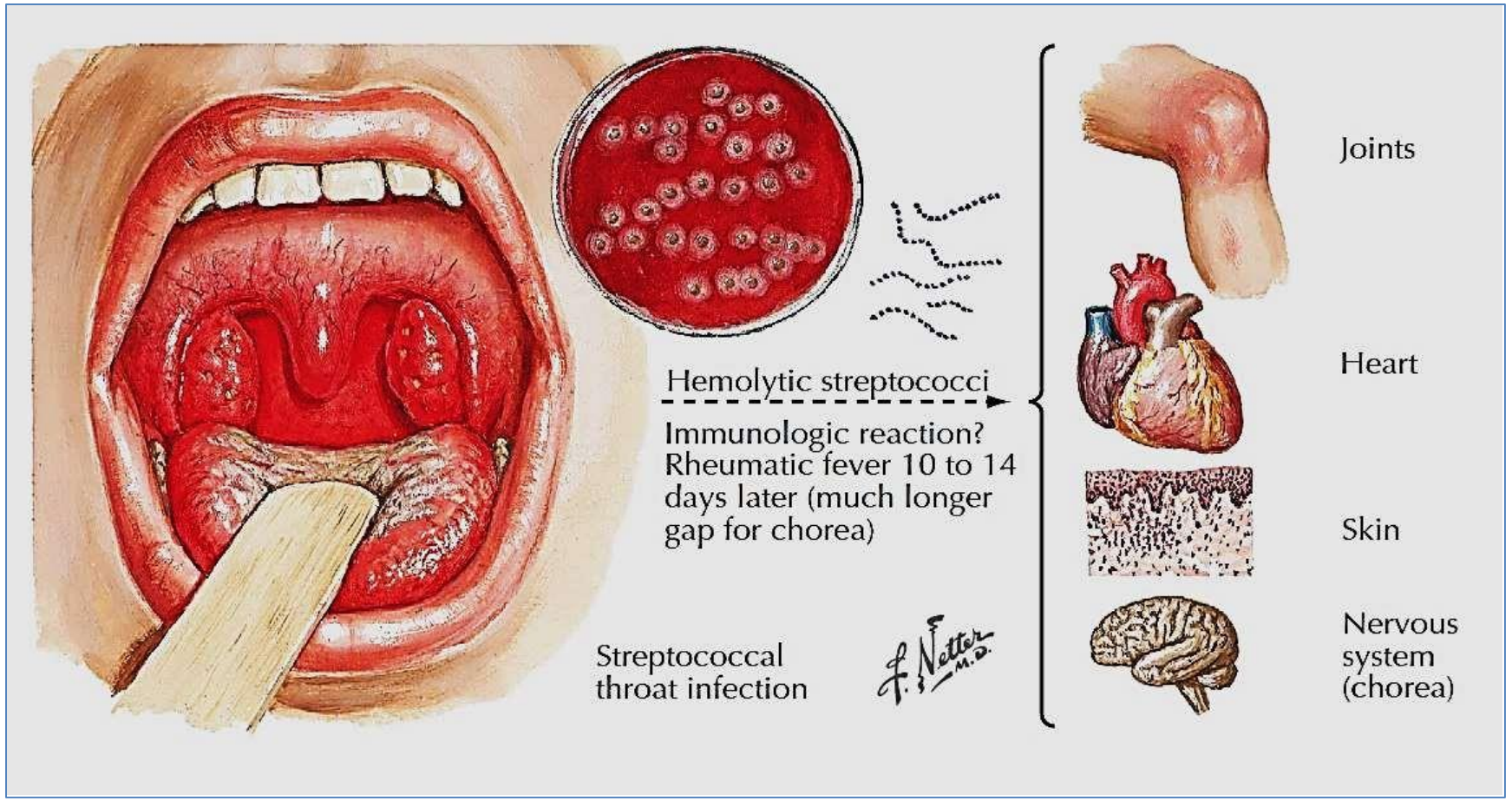
Rheumatic Fever



PATHOGENESIS:

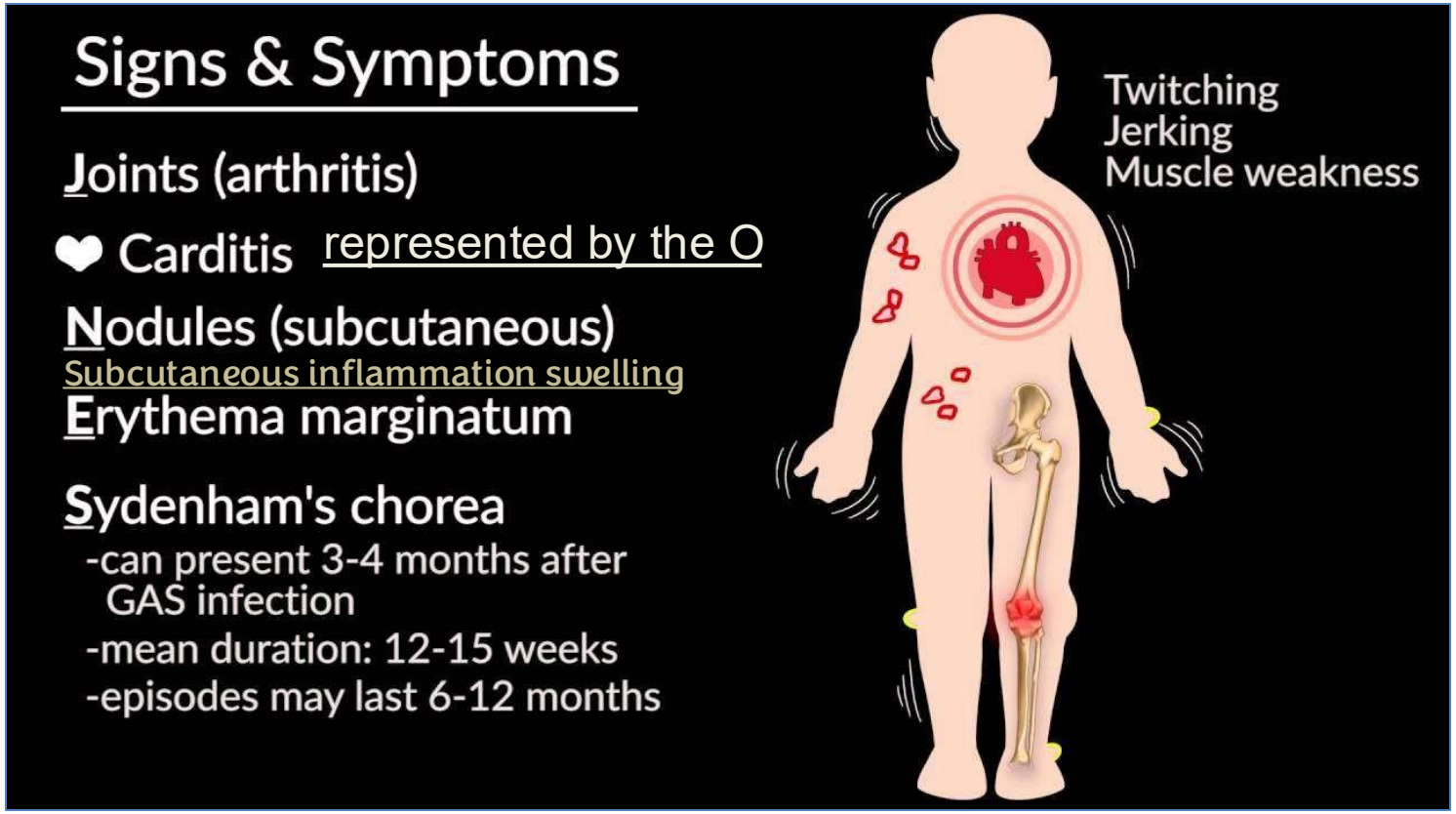
hypersensitivity reaction due to antibodies against group A streptococcal antigens

These antibodies are cross-reactive with host antigens, which are possibly presented in (heart, brain, joints, skin)

Rheumatic Fever

- Manifestations seen a few weeks after pharyngitis or skin infection
- Major organs involved: heart, joints, skin and brain
- 2 phases:
- Acute: fever, arthritis, CNS symptoms, carditis
- Chronic: cardiac valve disease, doesn't develop in all cases
- ……
- **Acute phase:**
- 80% children
- fever; migratory polyarthritis; **carditis, which will increase the suspicion of rheumatic fever**
- Carditis (arrhythmias, myocarditis, cardiac dilation, functional mitral insufficiency and CHF).
- ↑serum titers of antibody against streptococcal antigens (streptolysin O; DNA-ase)
- **culture for streptococci is usually (-) at the time of symptom onset because the acute pharyngeal infection typically occurs about two weeks before the onset of rheumatic fever**

Diagnosis of Acute Rheumatic Fever: The JONES Criteria



Related to the skin manifestations of Rheumatic fever

· Erythema → refers to the color of the lesion (red).
· Marginata → refers to the morphology of the lesion, characterized by distinct red margins.

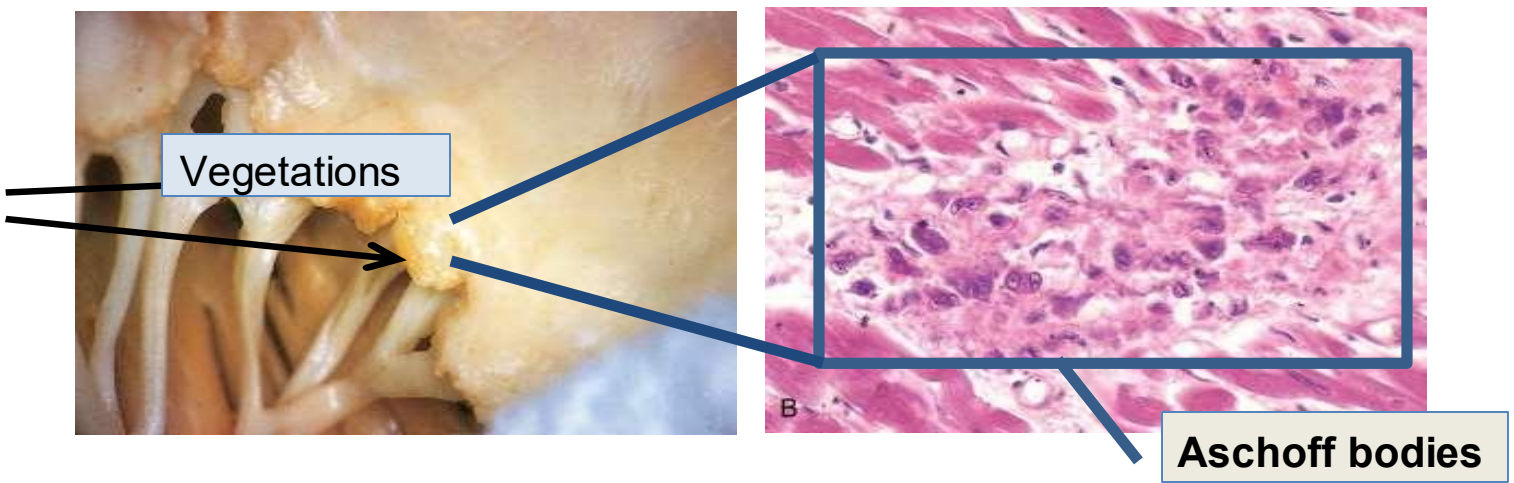
· Chorea: which is a manifestation represented by involuntary movement due to CNS problems

post-streptococcal autoimmune movement disorder characterized by involuntary, purposeless, rapid, irregular movements caused by anti-basal ganglia antibodies.

Carditis
Morphology- Acute Phase

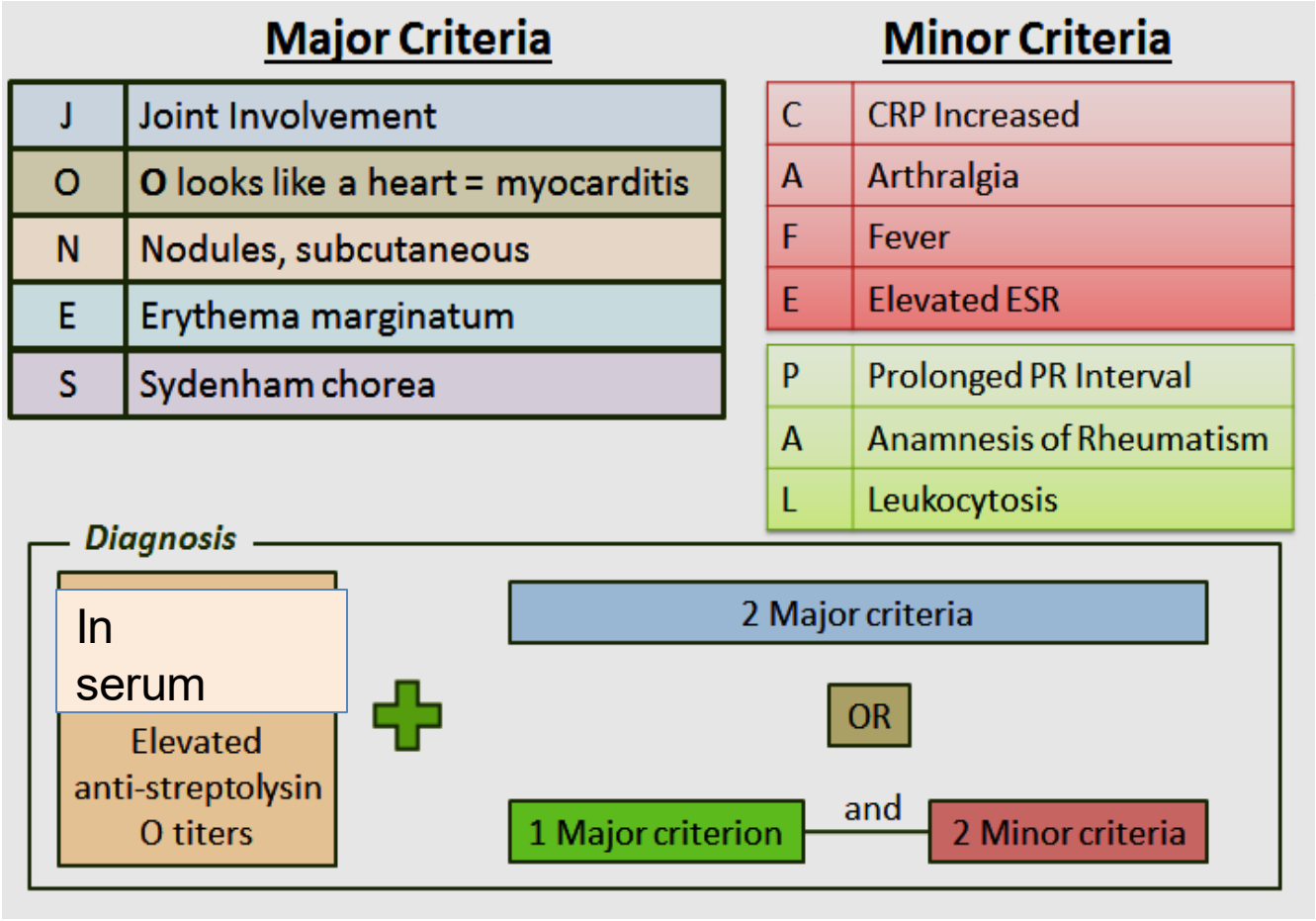
- Valve vegetations, which are thrombi on the cardiac valve that contain Aschoff bodies.
- **Aschoff bodies :**

- Are inflammatory lesions in affected tissues
- pathognomonic (diagnostic) for RF
- collections of T lymphocytes, plasma cells, and activated macrophages, which we see when we **examine the valve vegetation under the microscope.**



Diagnosis of Acute Rheumatic Fever

The previously discussed signs and symptoms, abbreviated by **JONES**, are the major criteria for diagnosing rheumatic fever.

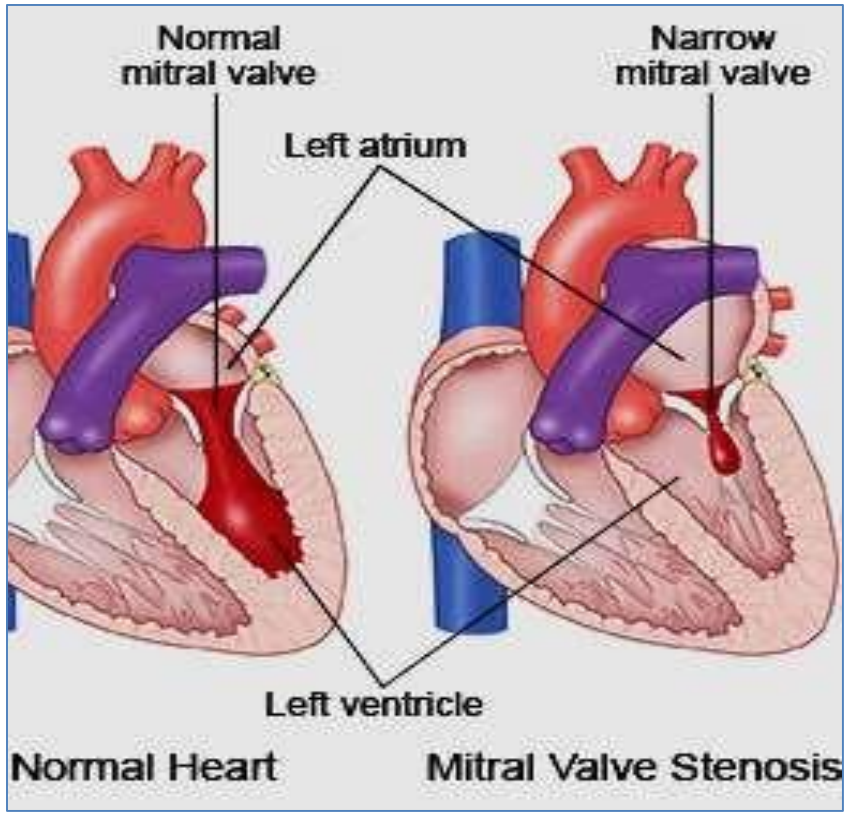


We can use some of these minor criteria to establish a diagnosis if we do not find enough major criteria.

Elevated anti-streptolysin O titers are a must for establishing a diagnosis, in addition to either of:

- 2 major criteria, or
- 1 major criterion and two minor criteria

Chronic Rheumatic Carditis- Clinical Picture



· Recall that not all patients will go through the chronic phase.

Onset: years/ decades after initial acute episode

· The chronic phase happens due to:
Chronic inflammation→ scarring →stenosis

• Symptoms include:
murmurs - CHF - arrhythmias- mural thrombi

• Prognosis: variable, depends on the affected valves and the severity of the problem.

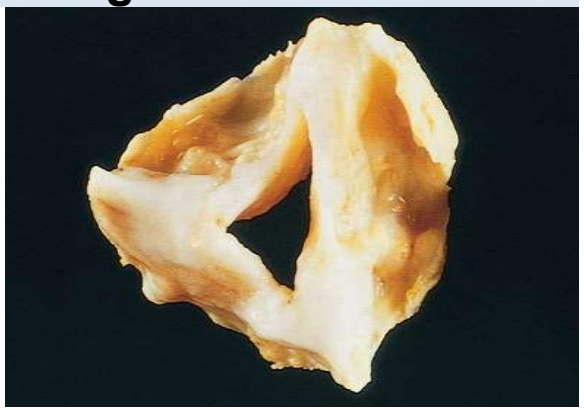
• Management: Surgical repair or replacement of the diseased valve.

· The diagram demonstrates a case of chronic rheumatic fever involving the mitral valve. Possible consequences of narrowing the mitral valve include dilatation of the left atrium, which can cause arrhythmias such as atrial fibrillation, as well as blood stasis that leads to thrombus formation and its resulting problems and complications.

Chronic Phase - Morphology

- Inflammation is followed by **scarring**
- Aschoff bodies **rarely** seen now (They are primarily seen in the acute phase)
- However, the chronic phase is characterized by the progression from inflammation to fibrotic healing, with replacement of damaged myocardium by collagen and fibrous tissue. As a result of the earlier Aschoff body–mediated injury, permanent valvular scarring and stenosis (most commonly mitral) develop.
- **Valve stenosis** (most imp. functional consequence)

Scarring and calcifications



mitral valve (m/c) aortic disease tricuspid valve
pulmonary valve (rare)

The Professor reiterates that:

- Chronicity = scarring and calcification of the valves. These usually result in stenosis, but regurgitation may also develop.
- All valves are possible targets of rheumatic fever, but the mitral valve is most commonly affected.
- Rheumatic fever is not an actual infection of the cardiac valves.

Infective Endocarditis

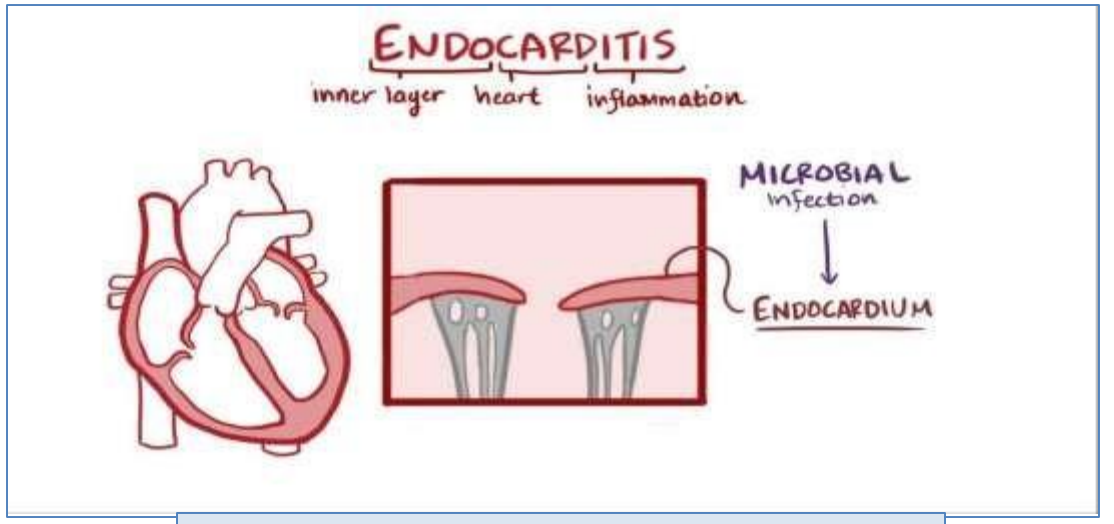
- As the name suggests, this is an actual infection involving the heart. Unlike this with rheumatic fever.
- This infection particularly involves the endocardium – the innermost layer of the heart and valves.

Infective Endocarditis (IE)

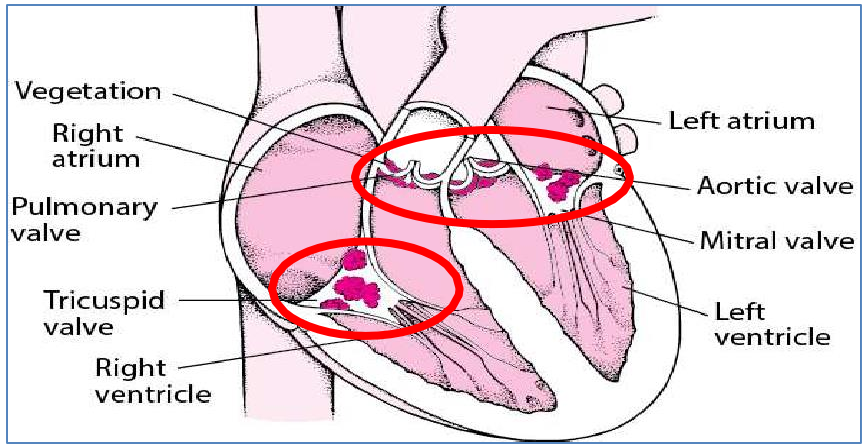
- Microbial (mostly bacterial*) invasion of heart valves and endocardium
- bulky, friable ***vegetations*** (necrotic debris+ thrombus+ organisms).

- Recall that vegetations are thrombotic deposits on cardiac valves. In infective endocarditis (IE), these vegetations are friable and contain live microorganisms, unlike the sterile verrucae of rheumatic fever. Consequently, when they detach, they form septic (infective) emboli that spread bacteria through the circulation, leading to the severe systemic complications characteristic of IE.

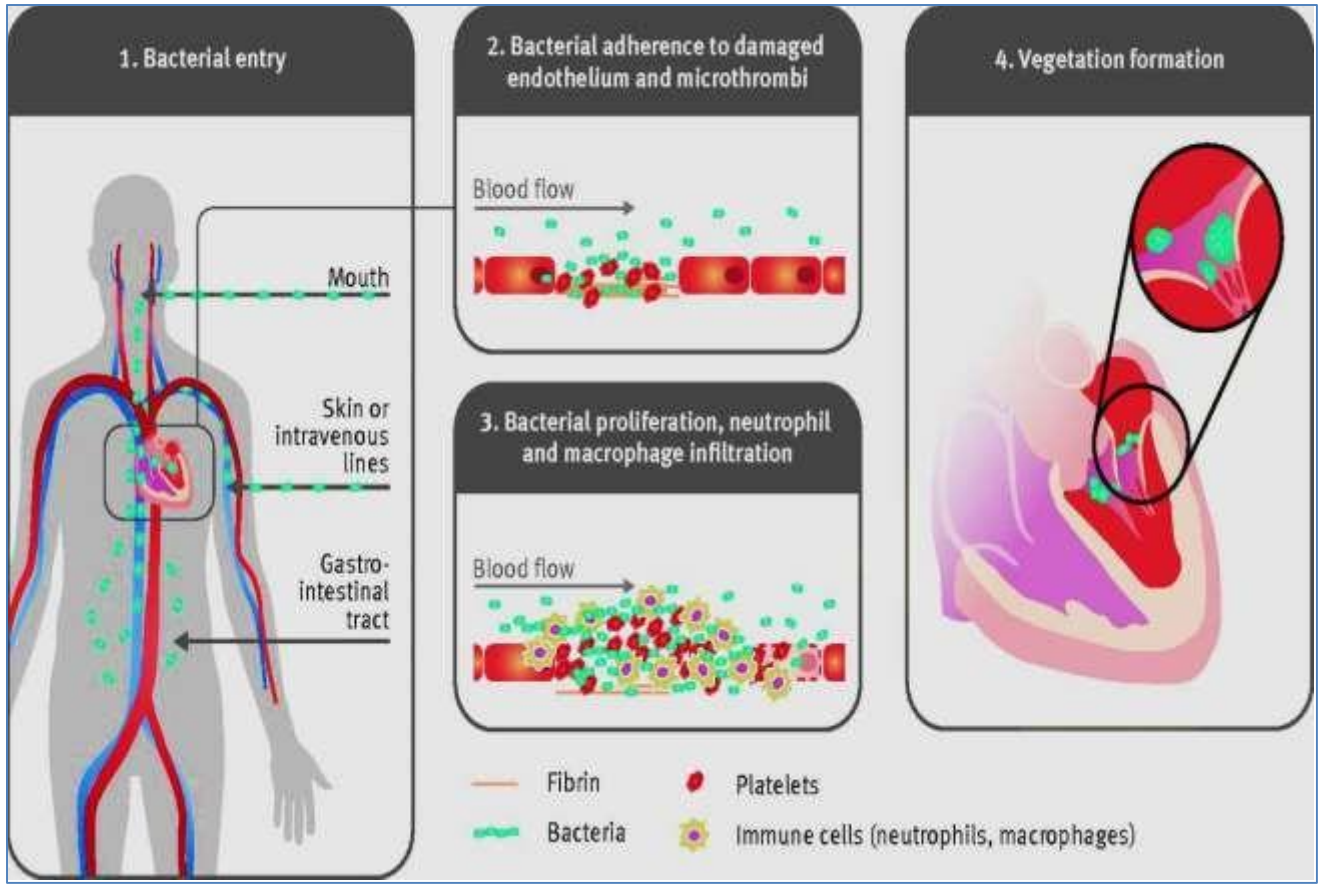
* others include: fungi, rickettsiae, and chlamydia



Infection of heart valves and endocardium

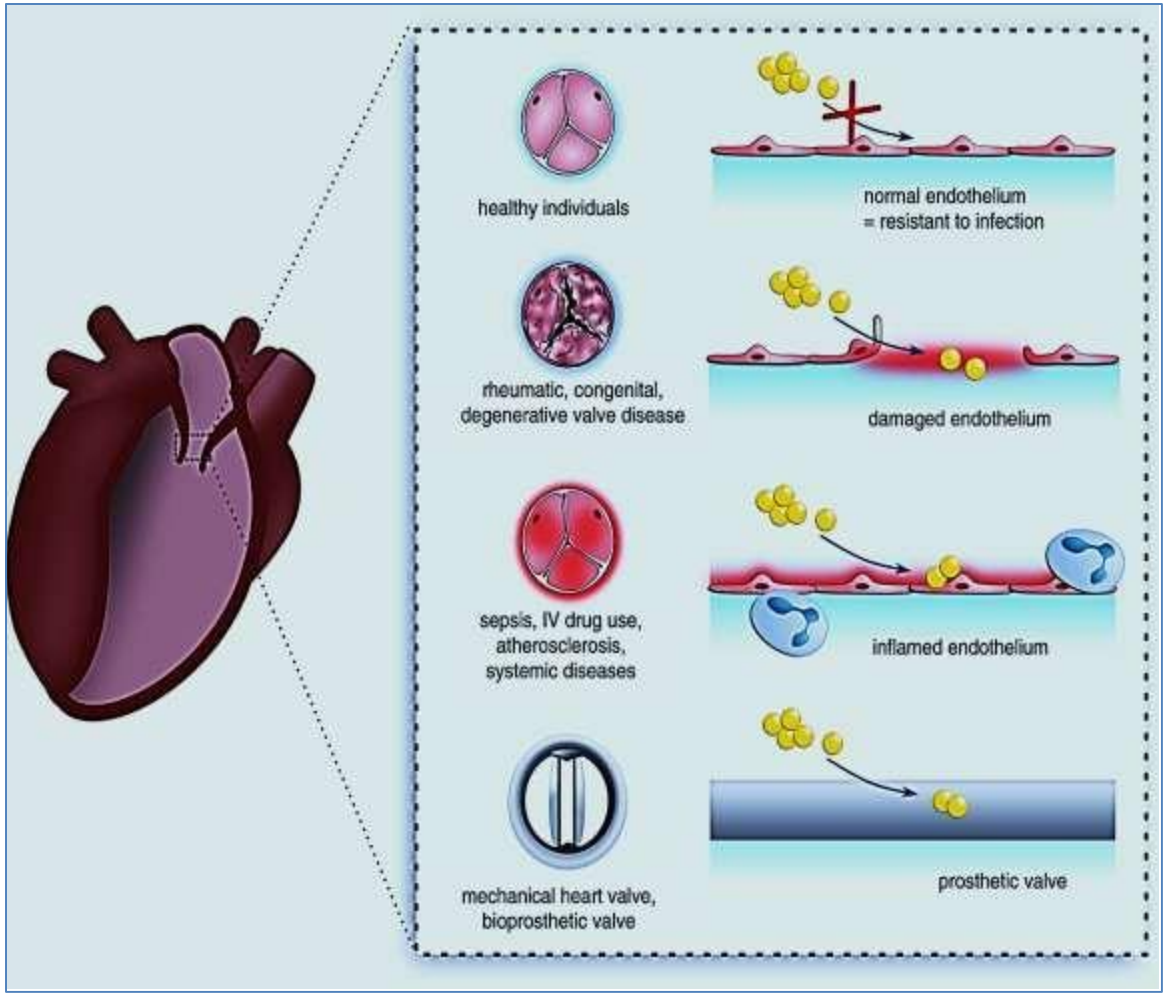


Infective Endocarditis
(Infection of heart valves and endocardium)



Infective Endocarditis- Risk Factors

- Congenital heart disease
- Acquired heart disease (including rheumatic fever)
- Indwelling vascular catheters
- Intra-cardiac devices & prostheses
- Immunodeficiency
- I.V. drug use/ abuse
- Septicemia
- ? Dental procedures (in patients with risk factors)

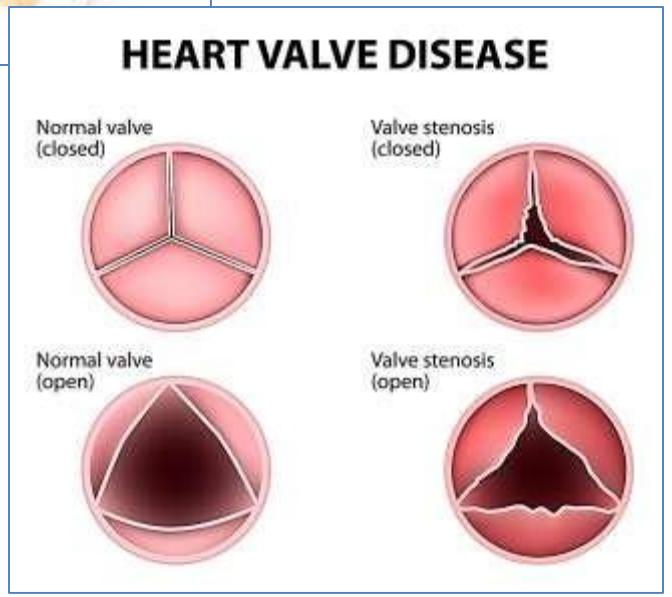


Dental procedures in patients with any of the above risk factors is a risk factor in itself.

Infective Endocarditis (IE) - classification

Classified into ***acute*** and ***subacute*** based on:

- the virulence of microorganism; a more virulent microorganism is more likely to produce acute IE, while a less virulent microorganism is more likely to produce subacute IE.
- presence of underlying cardiac disease



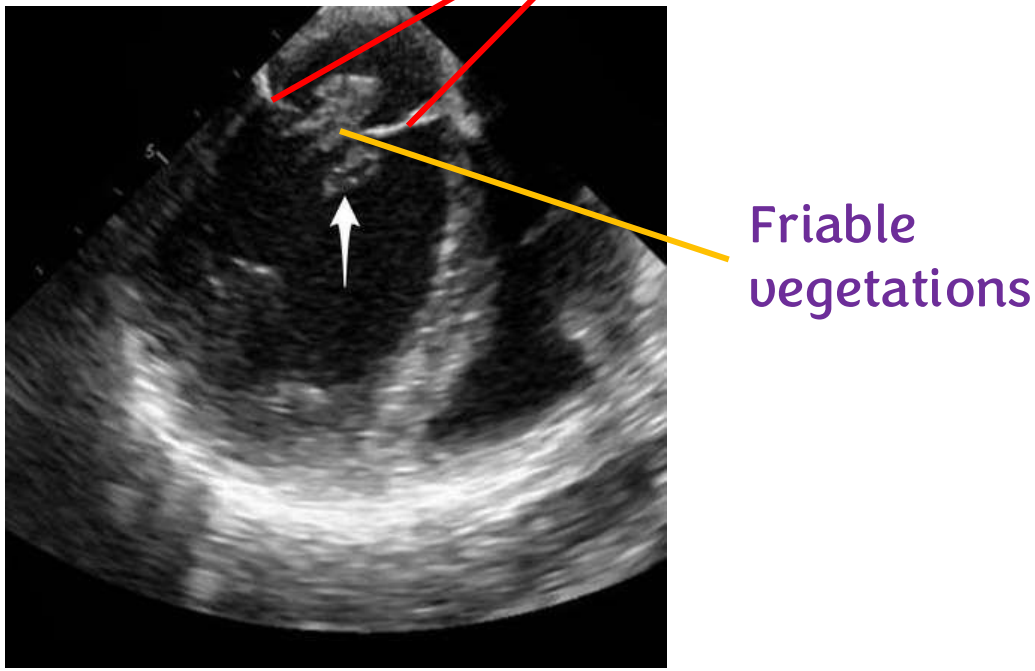
Acute and subacute IE differ in terms of:

- The rapid onset of the manifestations
- The progression/course of the disease
- The potential outcome

Feature	Acute endocarditis	Subacute endocarditis
Virulence	highly virulent organism	low virulent organism
Most common organism	Staph. aureus A highly aggressive microorganism	Streptococcus viridans Found in the oral cavity, usually as part of the normal flora
Underlying cardiac disease	previously normal valve Highly virulent microorganisms such as *Staph. aureus* can cause acute IE even in previously normal valves	previously abnormal valve (scarred or deformed) Less virulent microorganisms, such as *Strep. Viridans* are usually only able to cause subacute IE in previously abnormal valves. Previous abnormalities can be congenital (such as a bicuspid aortic valve) or acquired (such as rheumatic fever, which (again) is not infectious in itself, but causes inflammation and scarring in the valve, which makes it more prone to becoming infected as happens with IE)
Clinical course	rapidly developing	Insidious disease
Outcome	High morbidity and mortality	most patients recover after appropriate antibiotic therapy Since IE causes a very serious and deep-seeded infection, oral antibiotics are not enough; IV antibiotics must be given instead and treatment must be prolonged.

Infective Endocarditis- Clinical Features

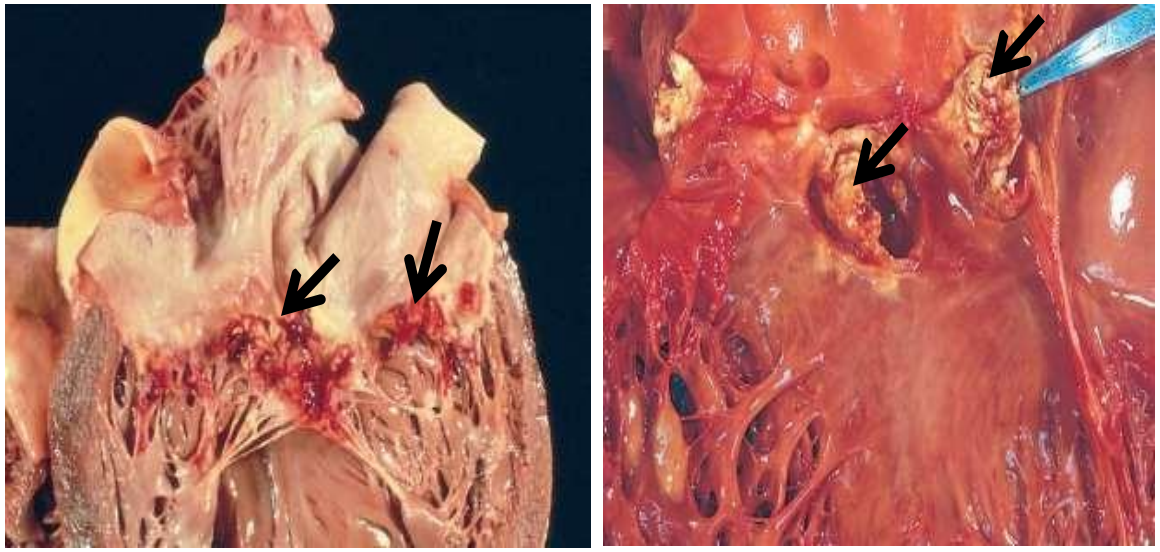
- Fever, chills, weakness, and murmurs
- **Valve vegetations can cause septic emboli** in different target tissues leading to serious problems.
- **Diagnosis* = (positive blood cultures + echocardiographic (echo) findings)**
- * depends on certain criteria known as the Dukes' criteria, but these are not required here



Infective Endocarditis- Morphology

- **Friable, bulky, and destructive vegetations** on heart valves
- Most common: aortic and mitral valves
- Tricuspid valve common in I.V. drug abusers → The reason for this is that IV drug abusers inject drugs into their veins. Eventually, venous return encounters the **tricuspid valve first**.
  Vein -> larger vein -> even larger vein -> superior/inferior vena cava -> right atrium -> tricuspid valve before entering the right ventricle.
  Again, all valves are still susceptible.

The black arrows in the picture to the left point to the large, friable, hemorrhagic vegetations over the affected cardiac valves (can be any valves, but mostly the aortic and mitral valves, except for drug abusers)



Clinical Features

- **<u>Complications of IE vegetations:</u>**

1. Septic emboli
2. Abscesses because the embolus carries the microorganism with it wherever it goes
3. septic infarcts where the embolus causes a vascular occlusion and an infection in the same place
4. mycotic aneurysms: dilatations in blood vessels as a result of infections

- **Treatment**: long-term (≥ 6 weeks) I.V. antibiotic therapy and/or valve replacement

Infective Endocarditis: Diagnosis

The Duke criteria are not required !!

Duke Criteria

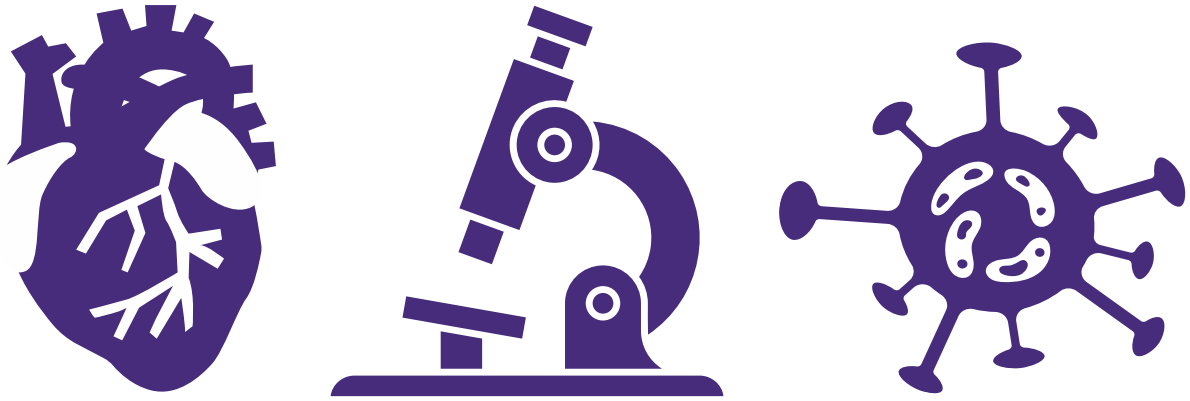
- 1994 a group at Duke University standardised criteria for assessing patients with suspected endocarditis
- **Definite**
  - 2 major criteria
  - 1 major and 3 minor criteria
  - 5 minor criteria
  - pathology/histology findings
- **Possible**
  - 1 major and 1 minor criteria
  - 3 minor criteria
- **Rejected**
  - firm alternate diagnosis
  - resolution of manifestations of IE with 4 days antimicrobial therapy or less

Modified Dukes' criteria

- **Major-**
  - 2 positive blood cultures, for an organism known to cause IE
    or
    persistent bacteremia- 2 +ve 12 hours apart or 3 of 4 +ve drawn over 1 hour
  - ECHO evidence- oscillating mass on valve or supporting structures
    or abscess
    or new valvular regurgitation or partial dehiscence of prosthetic valve
- **Minor-**
  - Predisposing factor- cardiac lesion, IVDU
  - Fever >38 °C
  - Vascular phenomenon
  - Immunologic phenomenon
  - +ve blood culture
  - +ve ECHO

Let’s find out?

- Are all people with streptococcal pharyngitis exposed to risk of rheumatic fever?
- In what ways are rheumatic fever and infective endocarditis similar?
- In what ways are rheumatic fever and infective endocarditis different ?



PATHOLOGY QUIZ LECTURE 8

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Corrections from previous versions:

Versions	Slide # and Place of Error	Before Correction	After Correction
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V1 → V2			