

# Pathology of Rheumatic heart disease, Infective endocarditis and Valvular heart disease



## Objectives:

At the end of this lecture, the students should be able to:

- (1) Understands the clinicopathological features of rheumatic heart disease which is a major cause of acquired mitral and aortic valve diseases in the Kingdom of Saudi Arabia.
- (2) Know the pathological causes and pathophysiological consequences of stenosis and incompetence of all the cardiac valves but particularly the mitral and aortic valves.
- (3) Understands the pathology of infective endocarditis so as to be able to identify patients at risk and when appropriate ensure prophylactic treatment is given.

[Editing file](#)

**Black:** original content.  
**Red:** Important.  
**Light Purple:** From Robbin's.  
**Blue:** only found in boys slides.

**Green:** Boy's doctor notes .  
**Dark orange:** Girl's Doctor notes.  
**Grey:** Explanation.  
**Pink:** Only found in girls slides.



# Rheumatic heart disease (RHD)



Helpful video

## Definition

It is a heart disease caused by **rheumatic fever (RF)** which is a condition that can result from inadequately treated streptococcal throat infection.

**It has two types:**

A- Acute

B- Chronic

## Rheumatic fever

<b>Definition</b>	An acute, immune mediated, multi-system, non-suppurative inflammatory disease that occurs a few weeks (1-5 weeks) after, group A-beta hemolytic streptococcal infection with cardiac and extracardiac manifestations
<b>Site</b>	Mainly in the heart, joints, central nervous system and skin.
<b>Epidemiology</b>	<ul style="list-style-type: none"><li>• Occurs in only <u>3%</u> of patients with group A streptococcal pharyngitis.</li><li>• It is seen mainly in children, 5 to 15 years of age.</li><li>• Rheumatic fever is a major health problem in 3rd world countries and in crowded, low socioeconomic urban areas.</li><li>• The incidence and mortality of rheumatic fever has declined over the past 30 years (due to improved socioeconomic condition and rapid diagnosis and treatment of strep. pharyngitis).</li></ul>

**Etiopathogenesis:** (The pathogenesis of RF remains unclear and is not yet completely understood)

the causative organisms (streptococci) stimulates the formation of antibodies

these antibodies cross react with certain antigens present in the heart and joints (because these antigens are similar to streptococcal antigen)

the antigen antibody reaction leads to inflammation.

**Repeated attacks or a single severe attack can lead to chronic rheumatic heart disease leading to cardiac failure.**

# Acute rheumatic heart disease (RHD)

## Cardiac manifestations of Rheumatic FEVER

- Also called acute rheumatic heart disease or acute rheumatic carditis/ pancarditis.
- What is pancarditis? It's the inflammation of all heart layers (Endocarditis, myocarditis, pericarditis)

### Pericarditis

- Inflammation of pericardium
- Lead to accumulation of secretions (fibrinous or serofibrinous) between the visceral & parietal layers
- Like butter between two slices of bread therefore also called "**bread & butter**" pericarditis

### Endocarditis

- Inflammation of endocardium, the valves (valvulitis) & chordae tendineae
- Results in fibrin deposition on valve leaflets forming tiny thrombi along lines of closure called **rheumatic vegetations**
- Mitral & aortic valves are mainly involved
- **Aschoff bodies/nodules are uncommon** in the valves
- May either resolve completely or progress to scarring with development of chronic fibrotic deformities of the heart valves and chordae tendineae leading to CHD many years later.

### Myocarditis

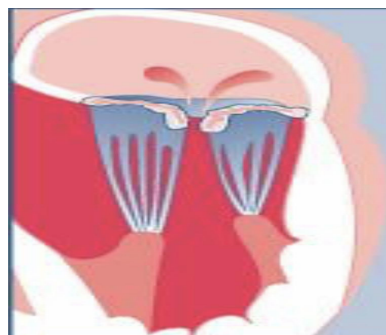
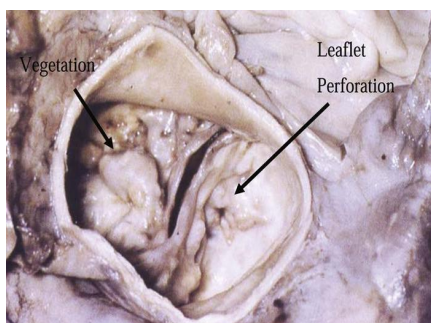
- Inflammation of myocardium
- Many **aschoff bodies** seen
- **Might cause sudden death**

### Subendocardial nodules

- Commonly seen in **left atrium**
- Called as **MacCallum plaques**

## What are Rheumatic vegetations?

- A mass of platelets, fibrin, microcolonies of microorganisms, and scant inflammatory cells.
- Tiny(size of pin's head), sessile arranged in a row and firmly with the underlying tissue.
- These are situated in the valve cusp, a few millimeters away from the free margin(this is the traumatized area)



Sterile  
vegetations

# Acute rheumatic heart disease (RHD)

## Aschoff bodies (characteristic lesion of rheumatic fever)

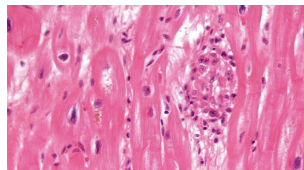
### Definition

They are multiple tiny granulomatous lesions of the heart, situated next to small arteries and are characteristically seen in the myocardium (rheumatic myocarditis).

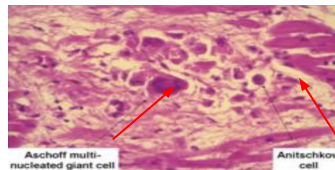
### Components

#### An Aschoff body, consists of:

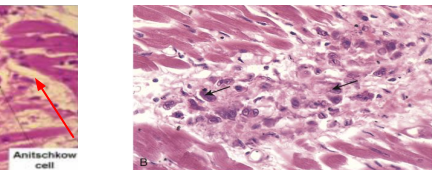
- Focus of eosinophilic collagen necrosis (representing the site of antibody-antigen reaction),
- Plump activated macrophages/ histiocytes called **Anitschkow/caterpillar cells**.
- Some of the macrophages become multinucleated to form Aschoff giant cells.
- Chronic inflammation.



Aschoff nodule



Aschoff multi-nucleated giant cell



B

### Site

- Found mainly in the myocardium and pericardium.
- Uncommon in the endocardium and heart valves.
- They ultimately "heal" by fibrosis resulting in a nodule of scar tissue.

## Extra cardiac (outside the heart) manifestations of Rheumatic FEVER

### Arthralgia

#### Migratory polyarthritis

- Which is "fleeting arthritis" in the large joints e.g. knee, ankle, elbow wrist etc. It is self limiting with no chronic deformities. Aschoff bodies may be present in the synovial membrane, joint capsule, ligament etc. with joint effusion.

### skin nodules and erythema marginatum.

#### Sydenhem's chorea (St. Vitus' dance)

- Characterized by series of rapid involuntary purposeless movements of the face and arms. This occurs late in the disease.

### Rheumatic nodules:

- mainly seen over the bony prominences e.g. knuckle, elbow, patella etc.

### chronic interstitial inflammation and fibrinous pleuritis.

- In lungs. it's uncommon.

# Acute rheumatic heart disease (RHD)

## Clinical features

- Acute symptoms usually subside within 3 months.
- The mortality from acute rheumatic carditis is low

Peak incidence: 5-15 years

**High** serum antistreptolysin O (ASO titer/ antibodies to group A streptococcal antigens)

History of sore throat  
(Symptoms start 10 days to 6 weeks after group A streptococcal pharyngitis)

**High** serum Anti-DNAase B

Throat/ pharyngeal cultures are usually negative.  
(When the symptoms start)

**High** serum Antihyaluronidase

## Jones criteria

- There is no specific test for rheumatic fever.
- The diagnosis is made based on the clinical findings when either:
- two major or one major and two minor criterias are met.

Mnemonic: "JONES CAFE PAL"

Major Criteria		Minor Criteria	
J	Joint Involvement	C	CRP Increased
O	O looks like a heart = myocarditis	A	Arthralgia
N	Nodules, subcutaneous	F	Fever
E	Erythema marginatum	E	Elevated ESR
S	Sydenham chorea	P	Prolonged PR Interval
		A	Anamnesis of Rheumatism
		L	Leukocytosis

### Major

#### Carditis:

Murmurs, pericardial friction rubs, weak heart sounds, tachycardia and arrhythmias cardiomegaly, pericarditis, and congestive heart failure.

**Migratory polyarthritits of the large joints**

**Erythema marginatum of the skin**

**Subcutaneous nodules**

**Sydenhem's chorea (St. Vitus' dance)**

### Minor

#### Elevated acute phase reactants:

- Elevated ESR (erythrocyte sedimentation rate).
- Increased CRP (C-Reactive protein).
- leukocytosis

**Arthralgia<sup>1</sup>**

**Fever**

**ECG changes**

Prolonged PR interval

**Previous rheumatic fever**

<sup>1</sup>: Pain of the joint with no infection . If there's an infection it's called arthritis

# Chronic rheumatic heart disease

Components of rheumatic fever

myocarditis and pericarditis

acute valvulitis or chordae tendinitis (Endocarditis)

Typically resolve without permanent sequelae (**without fibrosis**).

- heals by **fibrosis (scarring)**
- result in irreversible deformity (**leads to heart murmurs**).
- Severe valvular scarring develops **months** or **years** (10-15 years) **after** acute RF.
- Most harmful effect of rheumatic disease is due to involvement of cardiac valves. The valve leaflets develop **diffuse fibrosis**, become **thickened, shrunken**, and **less movable** which can lead to:
  - cardiac failure
  - thromboembolism
  - infective endocarditis.

## Valves affected:

Common side

**Left side of heart**

Most common

**Mitral valve**

common

**Combined mitral/aortic valve**

Rare

**Tricuspid valve**

Never

**Pulmonary valve**

## Type of damage to the valves

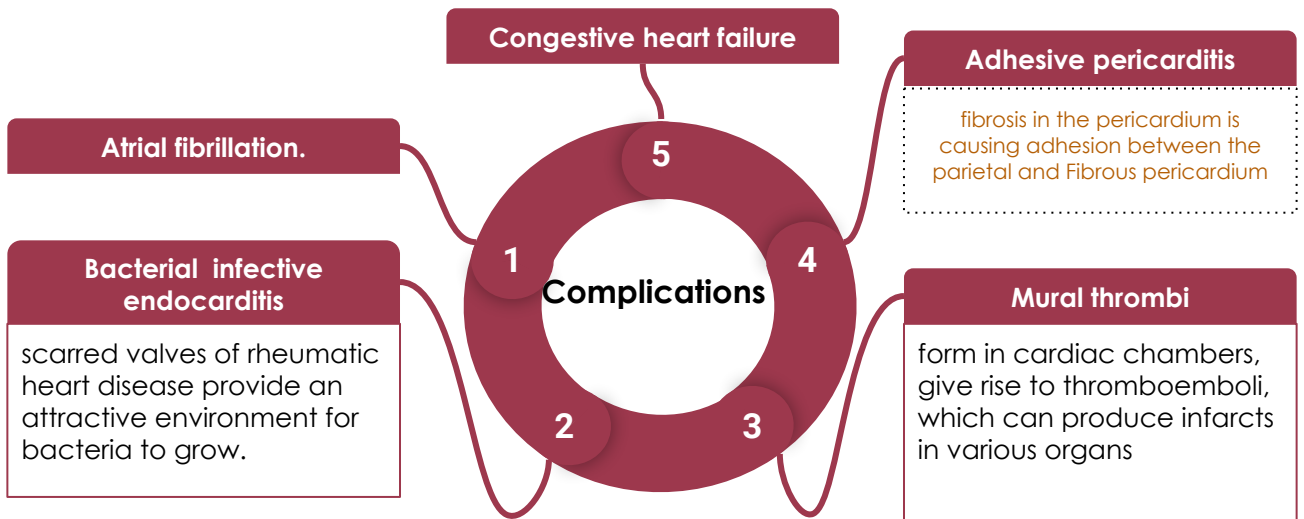
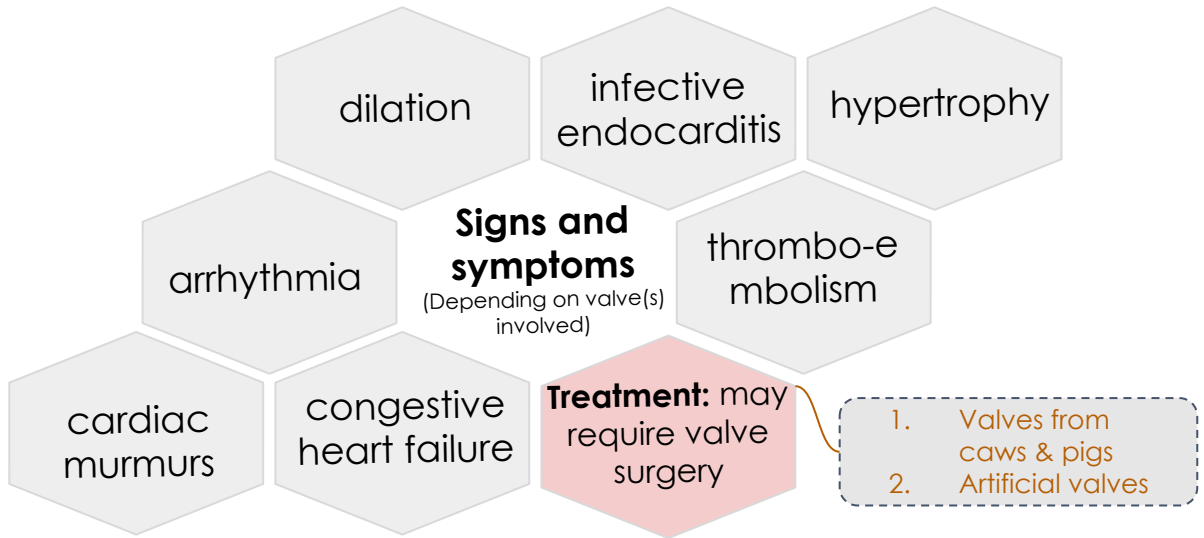
**stenosis (reduction of diameter)** →  
Fibrosis of valve leaflets

**regurgitation (improper closure)** →  
Fibrosis of chordae tendineae

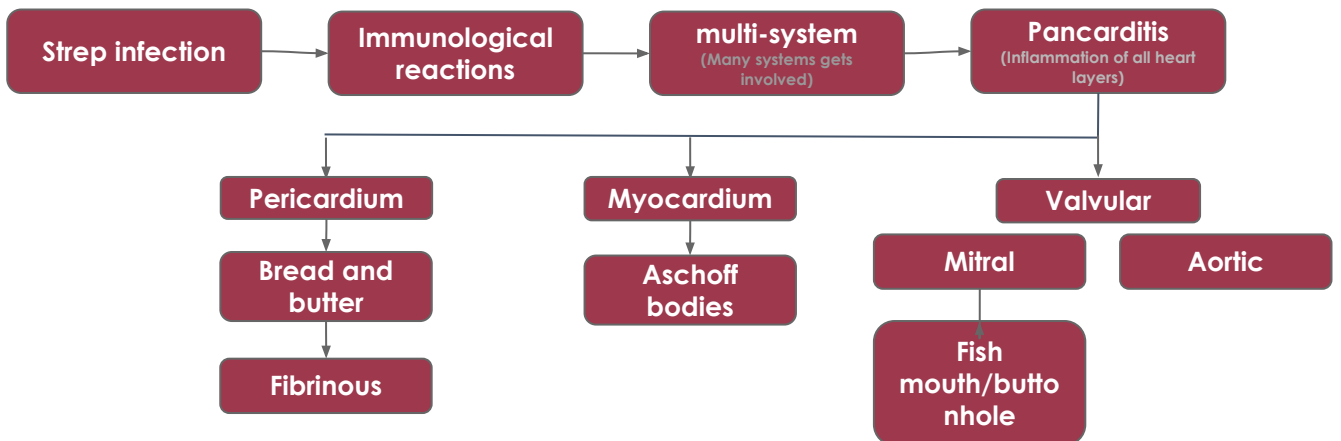
**Therefore patient can have mitral stenosis (most common), mitral regurgitation, aortic stenosis and aortic regurgitation.**

# Chronic rheumatic heart disease

Manifestations can continue for years or decades after the initial episode of rheumatic fever



## Summary:





# Infective Endocarditis (IE)<sup>1</sup>



Helpful video

## Definition

- ★ infection of the cardiac valves or mural/ inner surface of the endocardium, resulting in the formation of an adherent mass of thrombotic debris mixed with microorganisms.
- ★ Mitral valves are the most common sites of IE followed by aortic valve
- ★ Vegetations may be single or multiple, involve one or more valve(s), differ in appearance according to the causative agent.

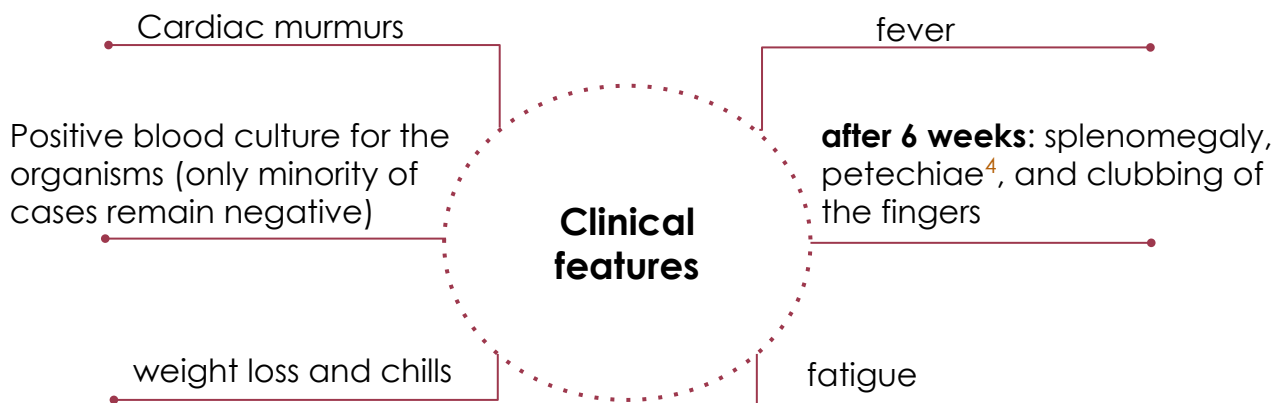
	Acute IE	Subacute IE
Infected valves	Normal/healthy	Previously abnormal/damaged
Causative organisms	Highly virulent organisms ( <b>staphylococcus aureus</b> )	Low virulence ( <b>a-hemolytic streptococci viridans</b> ) <sup>2</sup>
Progress	Rapidly	Slowly
Host reaction	Little local host reaction <sup>3</sup>	Induces local inflammatory reaction

### ❖ Prognosis:

depends to some extent on the offending organism and the stage at which the infection is treated. About 1/3rd of cases of Staphylococcus aureus endocarditis are still fatal.

### ❖ Why it's difficult to treat?

Infective endocarditis is a particularly difficult infection to eradicate **because of the avascular nature of the heart valves**. Endocardium gets most of the oxygen from the chambers of the heart by the flow of blood not capillaries so antibiotics won't be effective.



1: The difference between IE & the endocarditis rheumatic fever: The endocarditis rheumatic fever is non infectious (sterile) and aseptic. It's also a complication from a sore throat/pharyngitis. IE though is infectious (contains microorganisms)  
 2: because the valve is already damaged it doesn't need to be highly virulent to cause infection :)  
 3: due to the fast progression, the body does not get enough time to react  
 4: lesions in the skin



# Infective Endocarditis (IE)

## Risk factors

**In children:** an underlying cardiac lesion (congenital heart disease is most common).

**In adults:** More than half of adults with bacterial endocarditis have no predisposing cardiac lesion. **The rest:** Mitral valve prolapse and congenital heart disease are the most frequent cause for bacterial endocarditis in adults.

**Rheumatic heart disease**

**Transient bacteremia from any procedure** may lead to infective endocarditis e.g. dental procedures, urinary catheterization, infected indwelling vascular catheters gastrointestinal endoscopy, and obstetric procedures.

### Intravenous drug abusers<sup>1</sup>:

- end up injecting microorganisms intravenously when taking IV drugs, leading to IE.
- **The tricuspid valve:** most common site (half of the cases)
- **S. aureus:** in 50% of cases
- **Elderly** (due to degeneration of heart valves e.g. calcific aortic stenosis)
- **diabetics**
- **pregnant women**

**prosthetic valves:** Prosthetic valve endocarditis is caused commonly by **coagulase-negative staphylococci** (e.g. *S. epidermidis*).

## Complications

**Septicemia** or septic systemic embolization of infected vegetations which travel to multiple sites, causing infarcts or abscesses in many organs (e.g. neurologic deficits due to embolization to the brain or infarcts of the myocardium due to embolization to the coronary artery)

**Pulmonary emboli** is seen in tricuspid valve/ right sided endocarditis e.g. IV drug addicts.

**Arrhythmias, valvular regurgitation** and **congestive heart failure** (due to destruction of a valve).

**Valve ulceration & perforation, rupture of chordae tendineae.**

Mycotic/infected **aneurysms** of vessels & **renal failure**

1: Intravenous blood abusers share the same needles which cause infections → vein → inferior vena cava → right side of the heart → pumped to the body

2: The infected thrombus will break → descending aorta → throughout the body → blocks the area it lands in.

# Endocarditis

## Other types of Endocarditis

### Libman-Sacks endocarditis

Less common, non-infective, verrucous endocarditis associated with: **elevated levels of circulating immune complexes**. Seen in patients with **systemic lupus erythematosus**

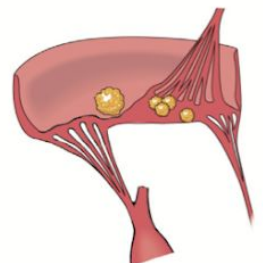
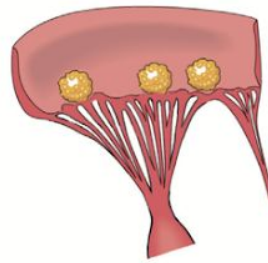
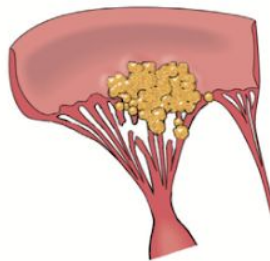
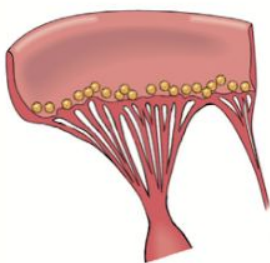
### Endocarditis of carcinoid syndrome

Secretory products of carcinoid syndrome, especially **5-hydroxytryptamine** can cause endocarditis. The endocardial plaques are seen in the **right side of heart**

### Nonbacterial thrombotic endocarditis (marantic endocarditis)

- Characterized by sterile (no infection) vegetations (small masses of fibrin, platelets, and other blood components) on the leaflets of the cardiac valves. There is no infective organism. It is aseptic.
- **Aortic valve** most common site. The fibrin deposits are randomly arranged.
- May embolize to different parts of the body including brain, but the emboli are sterile.
- Pathogenesis/ association:
  - a. Subtle endothelial abnormality
  - b. Hypercoagulability.
  - c. Association with malignancy (50%) and other debilitating diseases

### Diagrammatic comparison of the lesions in the four major forms of vegetative endocarditis



**RHD**  
(rheumatic heart disease)

The rheumatic fever phase of RHD is marked by a row of warty, small vegetations along the lines of closure of the valve leaflets.

**IE**  
(infective endocarditis)

characterized by large, irregular masses on the valve cusps that can extend onto the cords.

**NBTE**  
(nonbacterial thrombotic endocarditis)

typically exhibits small, bland vegetations, usually attached at the line of closure. One or many may be present.

**LSE**  
(Libman-Sacks endocarditis)

has small or medium-sized vegetations on either or both sides of the valve leaflets.

# Valvular heart diseases (VHD)



Helpful Videos

## Two basic types

### Stenosis of valves<sup>1</sup>

Failure to open

### Regurgitation of valves<sup>2</sup>

Insufficiency or failure to close<sup>3</sup>  
Both cause murmurs<sup>4</sup>

1: Almost always due to primary cuspal abnormality stemming from a chronic process (e.g., calcification or valve scarring)  
2: Result from either intrinsic disease of the valve cusps (e.g., endocarditis) or disruption of the supporting structures (e.g., the aorta, mitral annulus, tendinous cords, papillary muscles, or ventricular free wall) without primary cuspal injury.  
3: Thereby allowing regurgitation (backflow) of blood  
4: Produced from turbulent flow through diseased valves

## Causes:

1

Most common cause of acquired VHD: **post inflammatory scarring**. (e.g. late complication of rheumatic fever or secondary to various other inflammatory processes.)

3

Can occur even with prosthetic valves

2

Congenital

4

secondary to thrombus formation or infectious endocarditis.

## Right side of heart

### 1. TRICUSPID VALVE

- Rarely involved in rheumatic heart disease. When involved it is along with the mitral and aortic valves (not alone).
- 

### 2. PULMONARY VALVE

- Can be affected in congenital malformations e.g. tetralogy of Fallot
- Is very rarely involved in rheumatic heart disease

## 3. Aortic valve

### Aortic stenosis

- Commonly caused by calcification and is called as **calcific aortic stenosis**.
- **Calcific aortic stenosis affects:**
  - 1- Normal aortic valve as part of the aging degenerative process in > 60 yrs old.
  - 2- Congenital bicuspid aortic valve.
  - 3- Valves scarred by rheumatic heart disease.

### Aortic regurgitation/ insufficiency

- **Can be caused by:**
  - 1- Non-dissecting aortic aneurysm.
  - 2- Rheumatic heart disease.
  - 3- Infective endocarditis.
  - 4- Syphilitic (luetetic) aortitis (rare).



Normal Valve



Stenotic Valve

# Valvular heart diseases (VHD)

## 4. Mitral valve



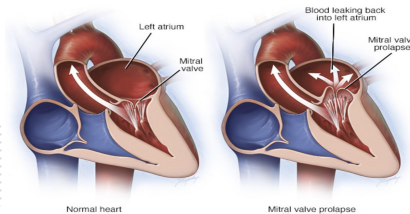
Helpful video

### Mitral valve prolapse (MVP)

- A condition in which the two valve flaps of the mitral valve do not close smoothly or evenly, but instead bulge (prolapse) upward into the left atrium.
- most frequent valvular lesion in developed countries.
- Seen in young women.
- Pathogenesis is unknown
- There is myxoid/mucoid degeneration<sup>1</sup> of the valve which causes ballooning of mitral valves (floppy cusp), results in stretching of the mitral valve, producing a **parachute deformity** of the cusp with prolapse of the cusp into the atrium during systole. These changes produce a characteristic **systolic murmur** (mid-systolic click).
- Most patients asymptomatic but can occasionally lead to mitral insufficiency and arrhythmias.
- Can be a component of Marfan syndrome<sup>2</sup>.
- Patients are predisposed to infective endocarditis.
- No vegetations, no fibrosis.

<sup>1</sup>: On histologic examination, the essential change is thinning of the valve layer known as the fibrosa layer of the valve, on which the structural integrity of the leaflet depends, accompanied by expansion of the middle spongiosa layer owing to increased deposition of myxomatous (mucoid) material.

<sup>2</sup>: a disorder of connective tissue that is caused by a defect in the gene controlling the production of fibrillin, and is characterized by abnormal elongation of the long bones and often by ocular and circulatory defects.

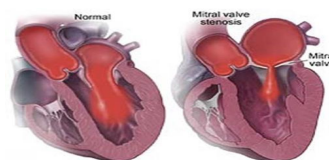


### Mitral stenosis

- More common than regurgitation.
- Most commonly due to rheumatic heart disease.

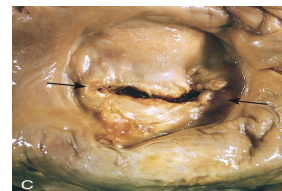
#### **Pathogenesis:**

Valve closed → blood can't flow to left ventricle which will increase the pressure in the left atrium leading to hypertrophy and dilatation → Due to high pressure in left atrium the blood coming from the pulmonary veins won't be able to fill in the left atrium → The blood will return to the lungs which will lead to pulmonary congestion and pulmonary hypertension → Right side of the heart may get affected later (leading to congestive heart failure)



- Leaflets are thickened, fibrotic and fused leading to fish mouth buttonhole deformity (stenosed valve looks like fish's mouth or buttonhole)
- secondary Ca<sup>++</sup> deposition.

No symptoms picked up when doing an investigation for something else.



### Mitral regurgitation

- Usually due to rheumatic heart disease.
- Can also be due to MVP, IE, papillary muscle injury in MI.
- Leads to left ventricular hypertrophy and dilatation.

# Summary

## Rheumatic Fever

<b>Types</b>	Acute		Chronic	
<b>Cause</b>	Post group A Streptococcus infection		Severe/repeated attacks of rheumatic fever	
<b>Characteristic</b>	Aschoff bodies		<ul style="list-style-type: none"> <li>• Scarring</li> <li>• Thickened valvular cusps</li> </ul>	
<b>Site</b>	<b>Pericarditis</b>	Fibrinous or serofibrinous "Bread and butter"	Left side of the heart	
	<b>Myocarditis</b>	Aschoff bodies		
	<b>Endocarditis</b>	Rheumatic vegetations	<ul style="list-style-type: none"> <li>• Mitral valve alone</li> <li>• or combination of mitral/aortic valve</li> </ul>	
	<b>Subendocardial lesions</b>	MacCallum plaques		
<b>Clinical features</b>	<ul style="list-style-type: none"> <li>• Elevated Antistreptolysin O</li> <li>• Jones criteria: <ul style="list-style-type: none"> <li>◦ Two major</li> <li>◦ One major and two minor</li> </ul> </li> </ul>		<ul style="list-style-type: none"> <li>• Cardiac murmurs</li> <li>• Thromboembolism</li> <li>• Infective endocarditis</li> </ul>	

## Infective Endocarditis

<b>Site of infection</b>	Mitral valve followed by aortic valve, Tricuspid valve is seen in IV drug users			
<b>Types</b>	Acute		Subacute	
<b>Cause</b>	Streptococcus Aureus		<i>α</i> hemolytic Streptococcus Viridans	
<b>Affect</b>	Normal valves		Damaged valves	
<b>Progress</b>	Rapid and 1/3 of cases are fatal		Slow	
<b>Clinical features</b>	<ul style="list-style-type: none"> <li>• Fever</li> <li>• Cardiac murmur</li> <li>• Petechiae</li> </ul>		<ul style="list-style-type: none"> <li>• Clubbing of the fingers</li> <li>• +ve blood culture for the organisms</li> <li>• Splenomegaly</li> </ul>	
<b>Complications</b>	<ul style="list-style-type: none"> <li>• Septicemia</li> <li>• Renal failure</li> </ul>		<ul style="list-style-type: none"> <li>• Valve ulceration and perforation</li> </ul>	

## Valvular Heart Disease

<b>Cause</b>	Post inflammatory scarring as a late complication of Rheumatic Fever			
<b>Types</b>	Stenosis		Regurgitation	
	Mitral	Aortic	Mitral	Aortic
<b>Cause</b>	RHD	Calcification	RHD	RHD

# Dr. AlRakabi notes

## Rheumatic fever

### Definition

A multi-system immune mediated disease, it's also considered to be the most common cause for valvular diseases.

### Pathogenesis

Pharynx infection by Group A streptococcus → Immune system recognize the M protein on Group A strept (has similar molecular structure to certain parts in the body, e.g. Heart) → produces M protein antibodies (will attack all sites that have similar structure to M protein → Antigen-antibody complex deposition → Complement cascade (C3a, C5a) which will recruit inflammatory cells → inflammation and CD4+ cells activation.

### Diagnosis

- 1- Throat swab culture.
- 2- Serological tests: Anti-streptolysin O , Anti-hyaluronidase.
- 3- Jones criteria (2 major or 1 major and 2 minor).

## Valvular diseases

Valvular diseases are either stenosis or regurgitation, both causes murmurs of the heart, Mitral valve is the most common valve involved followed by Aortic > tricuspid > pulmonary.

### Mitral stenosis (Due to rheumatic fever)

- Will cause Fish mouth deformity to the valve.
- Treated with antibiotics and anticoagulants before surgery to prevent endocarditis.

### Calcific aortic stenosis

- Due to old age.
- Dystrophic calcification leading to Bicuspid aortic valve.

### Myxomatous degenerative (floppy) mitral valve

- Mitral regurgitation.
- Systolic click is heard by stethoscope.
- Chordae tendineae is relaxed.

## Infective endocarditis

### Definition

Inflammation of the endocardium most commonly caused by bacteria.

### Types

- 1- **Acute:** More severe and caused by staphylococcus aureus.
- 2- **Subacute:** Less severe and caused by Streptococcus viridans.

### Risk factors

- 1- Congenital heart disease e.g. ASD, VSD.
- 2- Prosthetic (artificial) valve.
- 3- Rheumatic heart disease.
- 4- Drug addict (most common cause is S.aureus).

### Symptoms

- 1- Fever.
- 2- Roth spots.(Eye hemorrhage)
- 3- Osler's node (Painful).
- 4- Peteachiae.

## Other types of endocarditis

### Nonbacterial thrombotic endocarditis

- Marantic(due to wasting over time).
- Usually diagnosed at autopsies.
- Occurs in people with chronic disease,
- Doesn't show colonies of bacteria under microscope, only fibrin.

### Libman-Sacks endocarditis

- Presence of sterile vegetations in people with Systemic Lupus Erythematosus.
- Vegetations will be on the surface of the cusps (inner/outer), not the lines of closure.



# Quiz

Answer key: [Answers](#) [Explanation File](#)

U (1: 8 (2: 5 (8: U (4: U (9: U (9

1) A 30-year-old woman presents with a heart murmur and SLE. There is a history of recurrent episodes of arthritis, skin rash, and glomerulonephritis. Blood cultures are negative. Laboratory tests for antinuclear antibodies (ANA) and anti-double-stranded DNA are positive. Which of the following is the most likely cause of heart murmur in this patient?

A) Libman-Sacks endocarditis

B) Mitral valve prolapse

C) Myocardial infarct

D) Angina pectoris

E) Rheumatic fever

2) A 16-year-old girl, who arrived in the United States from Africa, comes to the hospital with chest pain and respiratory distress. On physical examination, the patient is short of breath, wheezing, and gasping for air. A prominent pansystolic heart murmur and a prominent third heart sound are heard on cardiac auscultation. An X-ray study of the chest shows marked enlargement of the heart. The patient expires despite intense supportive measures. At autopsy, microscopic examination of the myocardium discloses aggregates of mononuclear cells arranged around centrally located deposits of eosinophilic collagen. What is the appropriate diagnosis?

A) Acute bacterial endocarditis

B) Rheumatic heart disease

C) Subacute bacterial endocarditis

D) Systemic lupus erythematosus

E) Viral myocarditis

3) A 40-year-old woman with a history of rheumatic fever presents with shortness of breath, weight loss, fatigue, and abdominal distension. Physical examination shows rales in the lungs, hepatosplenomegaly, and 2+ pitting edema of the legs. A chest X-ray reveals only left atrial enlargement and pulmonary edema. What is the most likely cause of pulmonary edema in this patient?

A) Aortic insufficiency.

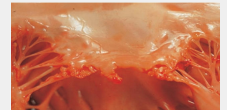
B) Aortic stenosis.

C) Mitral stenosis.

D) Pulmonic stenosis.

E) Tricuspid insufficiency.

4) A 53-year-old woman presents with a 6-week history of fever, fatigue, and weight loss. Her temperature is 38.7°C (103°F), pulse rate 110 per minute, and blood pressure 140/80 mm Hg. Physical examination reveals petechiae and clubbing of the fingers. The patient develops mental status changes, suffers a massive stroke, and expires. The mitral valve is examined at autopsy (shown in the image). Which of the following is the appropriate pathologic diagnosis?



A) Bacterial endocarditis.

B) Carcinoid heart disease

C) Libman-Sacks endocarditis

D) Marantic endocarditis

E) Marantic endocarditis

5) A 10-year-old boy with a 2-week history of an upper respiratory infection was admitted to the hospital with malaise, fever, joint swelling, and diffuse rash. The patient is treated and discharged. However, the patient suffers from recurrent pharyngitis and, a few years later, develops a heart murmur. This patient's heart murmur is most likely caused by exposure to which of the following pathogens?

A) Beta-hemolytic streptococcus

B) Candida albicans.

C) Epstein-Barr virus

D) Staphylococcus aureus

E) Streptococcus viridans

6) For the patient described in Question 5, which of the following is the most common life-threatening complication of his valvular heart disease?

A) Congestive heart failure

B) Dissecting aneurysm.

C) Hemolytic anemia

D) Myocardial infarction

E) Pulmonary thromboembolism

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THANK YOU