

# AORTIC VALVE DISEASE

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Roll No:30



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Etiology, pathophysiology, clinical features, diagnosis, management

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## CLINICAL SCENARIO

A **70-year-old male** with a history of **hypertension** and **type 2 diabetes** presents with **progressive breathlessness** over the past **one year**, initially on exertion but now occurring even at rest. He also complains of occasional **chest tightness** while walking and two episodes of **dizziness** in the last three months. His family reports that he has recently become less active and fatigued easily.

On examination, his **pulse** is **slow-rising** and **low** in **volume**. There is a **heaving apex beat**, and auscultation reveals a **harsh systolic murmur** loudest at the right second intercostal space, radiating to the carotids. His blood pressure is **110/70** mmHg.



- 1. What is the most likely diagnosis?**
- 2. What is the classical triad of symptoms in this condition?**
- 3. What are the key physical examination findings?**
- 4. What investigations would you order to confirm the diagnosis?**
- 5. What are the echocardiographic criteria for severe disease?**
- 6. What complications can arise if this condition is left untreated?**
- 7. What are the treatment options available ? When is surgery indicated?**
- 8. How does aging contribute to the development of this condition?**

# 1. Introduction



**The heart valves allow forward movement of blood through the cardiac chambers when they are open and prevent backward flow when they are closed.**

**A diseased valve may become narrowed, obstructing forward flow, or become leaky, causing backward flow or regurgitation.**



## 2.TYPES



### AORTIC STENOSIS

- Occurs when aortic valve becomes narrowed
- Obstructing forward flow



### AORTIC REGURGITATION

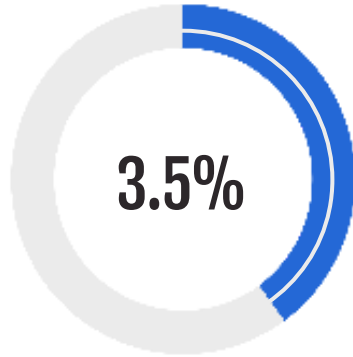
- Occurs when aortic valve becomes leaky
- Causing backward flow of blood



# Global Burden of Valvular heart Disease



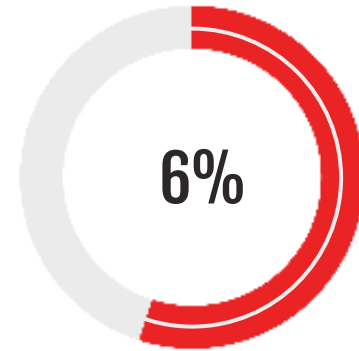
Prevalence –increases significantly with age



**Age>75yrs  
Severe Aortic  
Stenosis**



**Age>75yrs  
Significant left sided  
valve disease**



**Age>65yrs  
undiagnosed moderate  
or severe valvular heart  
disease**

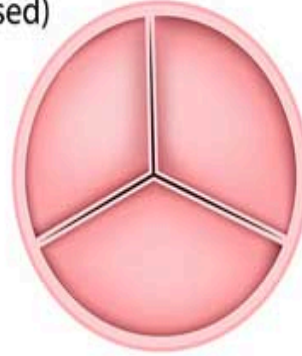
**The incidence of newly diagnosed valvular heart disease at 64 per 100,000 person-years.**

# Aortic Stenosis

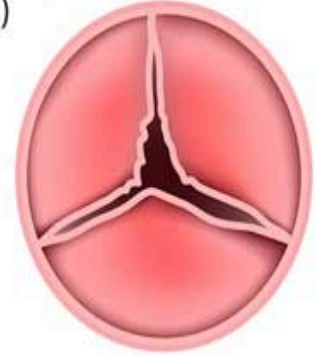
## 1. AORTIC STENOSIS

- It is an aortic valve disease that occurs when the aortic valve narrows, restricting blood flow from the heart to the body.
- Predominantly affects males

Normal valve  
(closed)



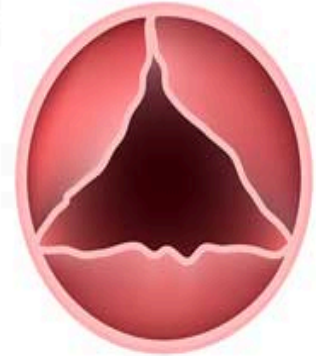
Valve stenosis  
(closed)



Normal valve  
(open)



Valve stenosis  
(open)



## Etiology



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## 16.84 Causes of aortic stenosis

### Infants, children, adolescents

- Congenital aortic stenosis
- Congenital subvalvular aortic stenosis
- Congenital supra-aortic stenosis

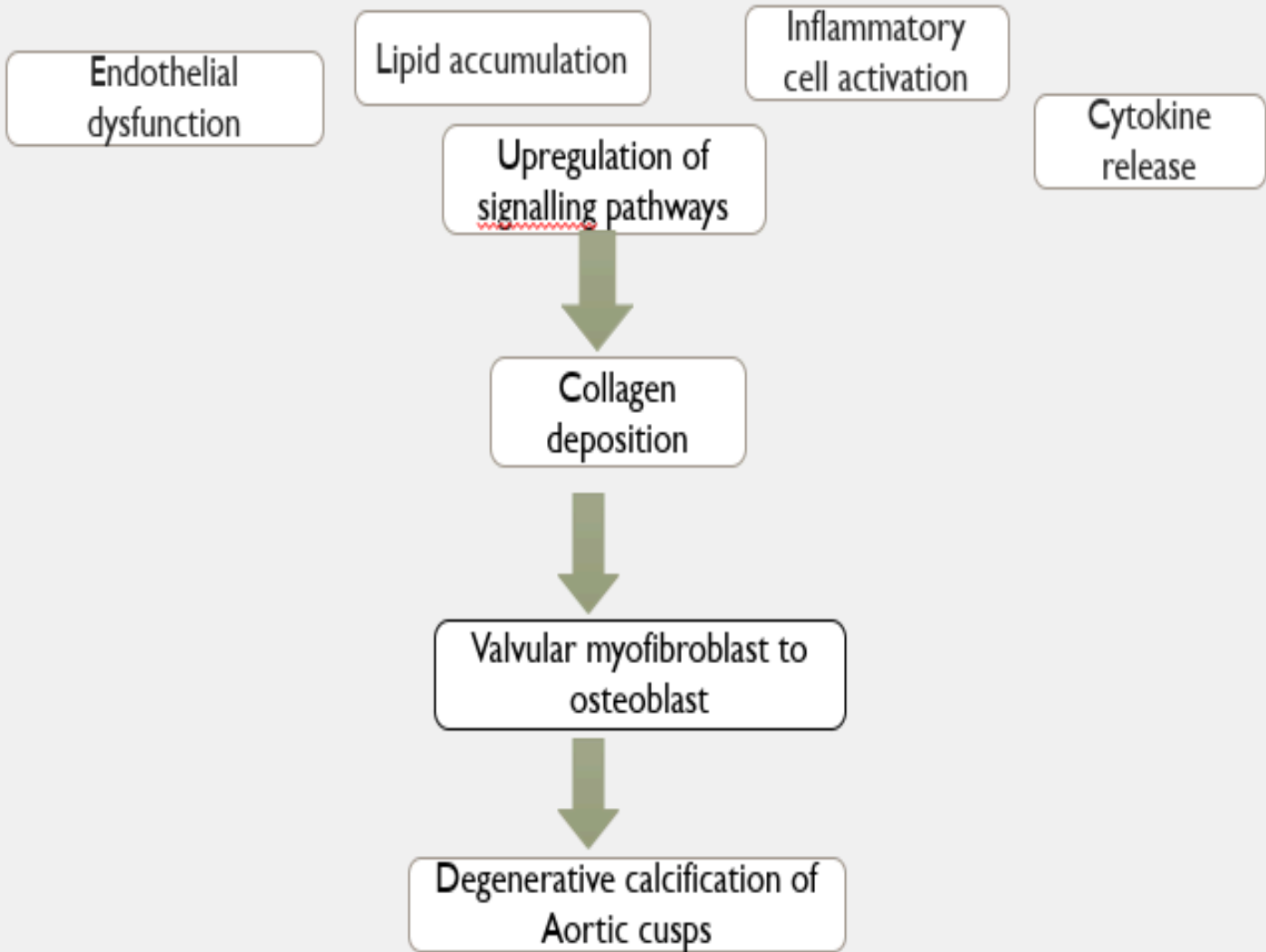
### Young to middle-aged adults

- Calcification and fibrosis of congenitally bicuspid aortic valve
- Rheumatic aortic stenosis

### Middle-aged to older adults

- Senile degenerative aortic stenosis
- Calcification of bicuspid valve
- Rheumatic aortic stenosis

# Pathogenesis



# Differential diagnosis of obstruction to LV outflow



**Hypertrophic  
obstructive  
cardiomyopathy**



**Discrete fibromuscular/  
membranous subaortic  
stenosis.**



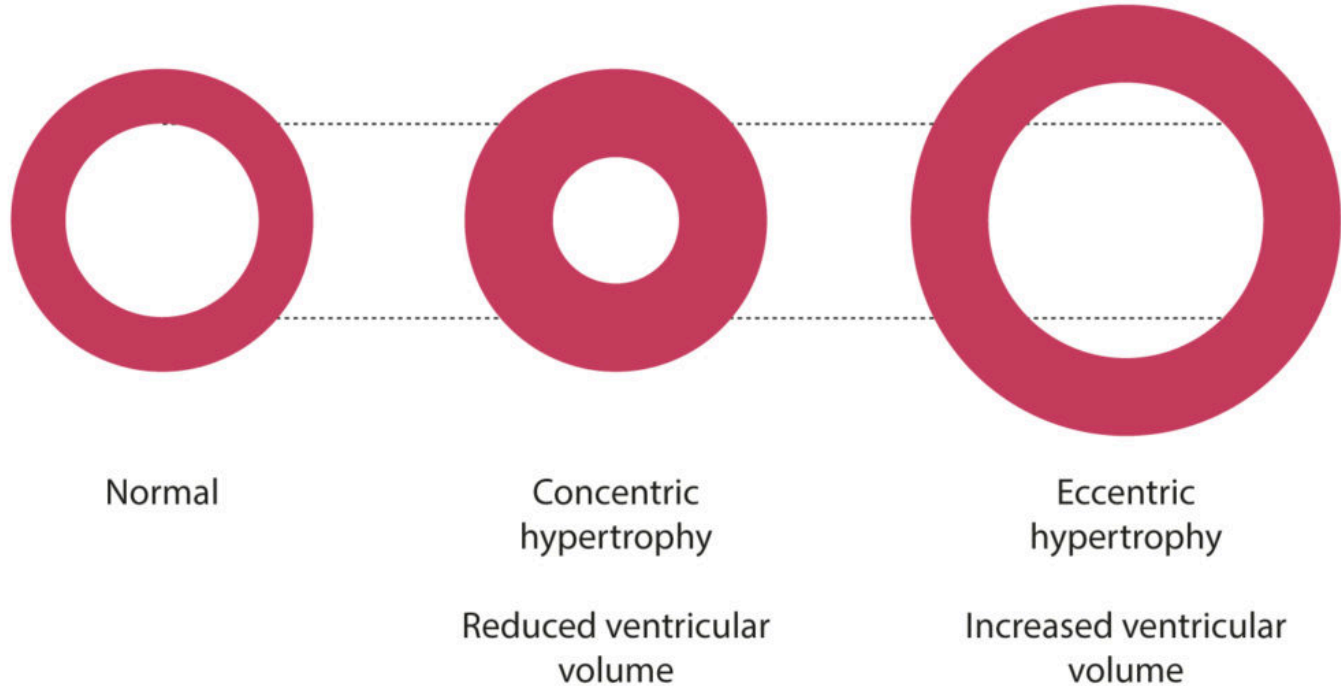
**Supravalvular AS**

# Pathophysiology

- \* The obstruction to LV outflow produces a systolic pressure gradient. between LV and aorta.
- \* With progression of the stenosis, the LV undergoes concentric hypertrophy \* Coronary blood flow may be inadequate to supply the myocardium, such that angina can develop even in the absence of coexisting CAD.
- \* The fixed outflow obstruction limits the increase in cardiac output required on exercise.
- \* Eventually, the LV can no longer overcome the outflow tract obstruction results in LV failure leading to pulmonary oedema.

## Types of hypertrophy

Parasternal shortaxis view of the left ventricle



# Clinical features



**Mild or moderate AS - usually asymptomatic**

**Cardinal symptoms of severe aortic stenosis  
( valve surface area  $<1\text{cm}^2$  and  
pressure gradient  $> 40\text{mm/Hg}$ )**

- 1. Angina**
- 2. Syncope**
- 3. Dyspnea**

# Classical Triad

## Angina

Due to increased demand of hypertrophied LV working against high pressure outflow obstruction or coexisting CAD(>50% patients)

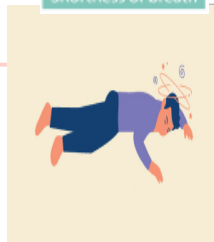


## Syncope

Usually occurs on exertion when cardiac output fails to rise to meet demand, leading to a fall in BP.



Shortness of breath

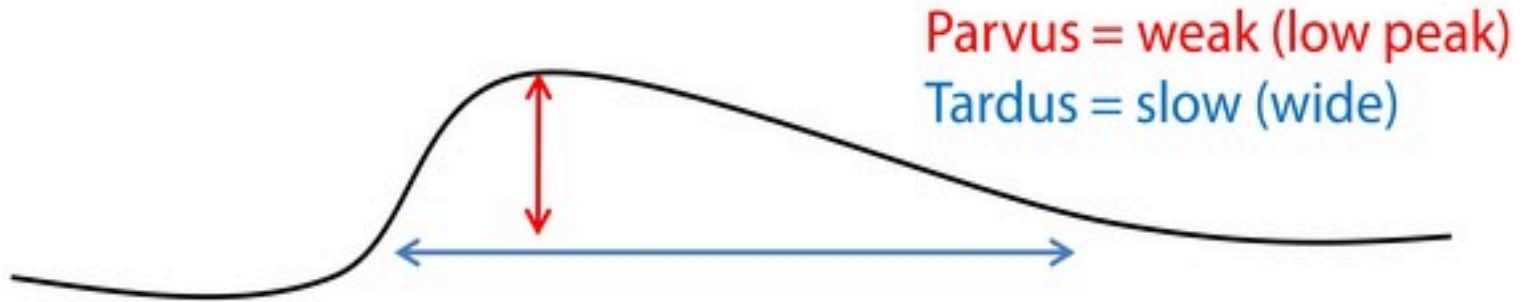



## Dyspnea

Exertional breathlessness suggests cardiac decompensation as a consequence of the excessive pressure overload placed on the LV.

## Clinical Signs

- **Narrow pulse pressure** - due to fall in systolic pressure when stroke volume decreases in late stages.
- **Pulse** - *pulsus parvus et tardus* - carotid pulse rises slowly to a delayed peak.

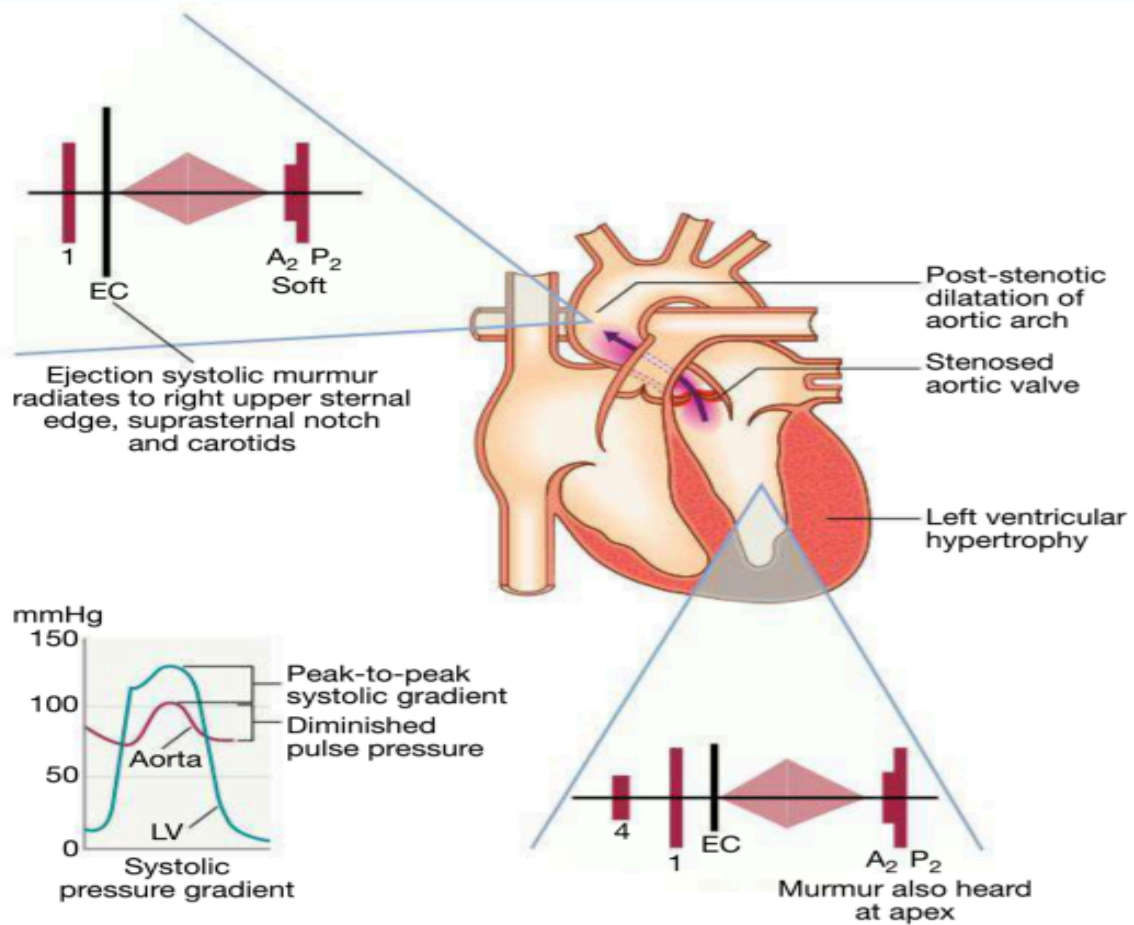


- **A thrill or anacrotic shudder**  may be palpable over the carotid arteries, more commonly the left.
- **Heaving apex beat (left ventricular pressure overload)**
- **Signs of pulmonary venous congestion - dyspnea, orthopnea, cough with frothy sputum, tachypnea**
- **Ejection systolic murmur – harsh, saw cutting wood like with diaphragm at aortic outflow and apex**

*"PULSES PARVUS ET TARDUS"*

**PERIPHERAL PULSES  
ARE OFTEN  
WEAK AND DELAYED**





**Fig. 16.82 Aortic stenosis.** Pressure traces show the systolic gradient between left ventricle (LV) and aorta. The 'diamond-shaped' murmur is heard best with the diaphragm in the aortic outflow and also at the apex. An ejection click (EC) may be present in young patients with a bicuspid aortic valve but not in older patients with calcified valves. Aortic stenosis may lead to left ventricular hypertrophy with a fourth sound at the apex and post-stenotic dilatation of the aortic arch. Fig. 16.11 shows the typical Doppler signal with aortic stenosis

**i**

## 16.85 Clinical features of aortic stenosis

### Symptoms

- Mild or moderate stenosis: usually asymptomatic
- Exertional dyspnoea
- Angina
- Exertional syncope
- Sudden death
- Episodes of acute pulmonary oedema

### Signs

- Ejection systolic murmur
- Slow-rising carotid pulse
- Thrusting apex beat (left ventricular pressure overload)
- Narrow pulse pressure
- Signs of pulmonary venous congestion

# INVESTIGATIONS



1

ECG

2

ECHOCARDIOGRAPHY

3

DOPPLER

4

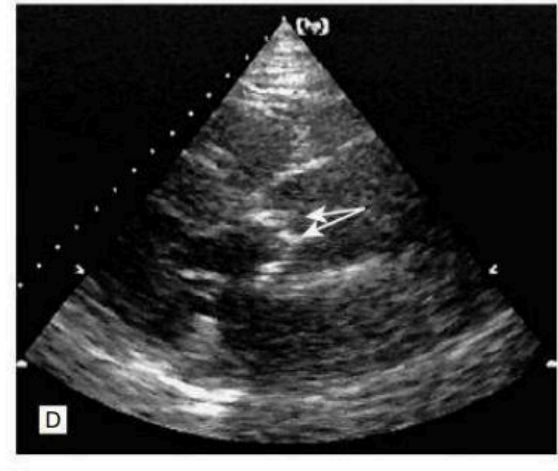
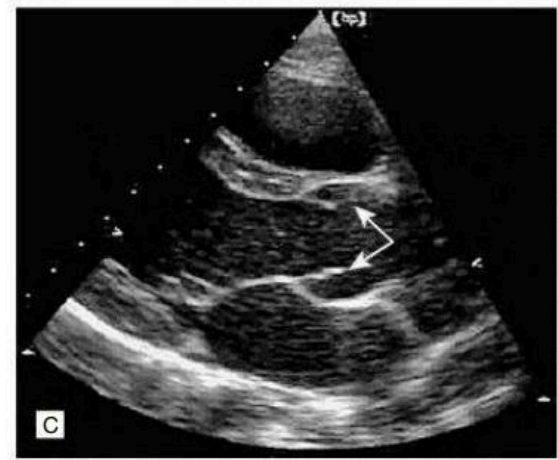
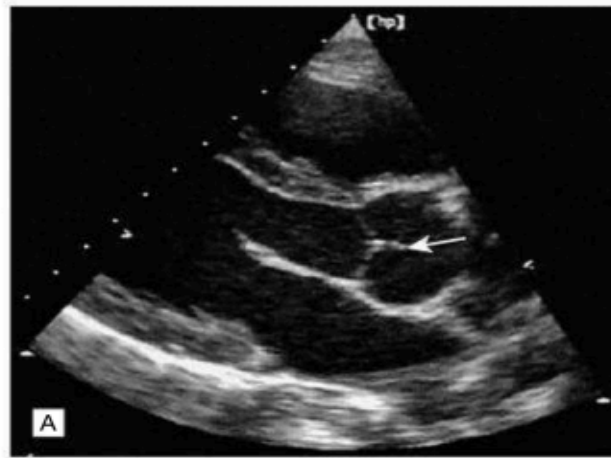
CARDIAC  
CATHETERISATION

5

CHEST XRAY

# Echocardiography

Demonstrate restricted  
valve opening  
LV hypertrophy

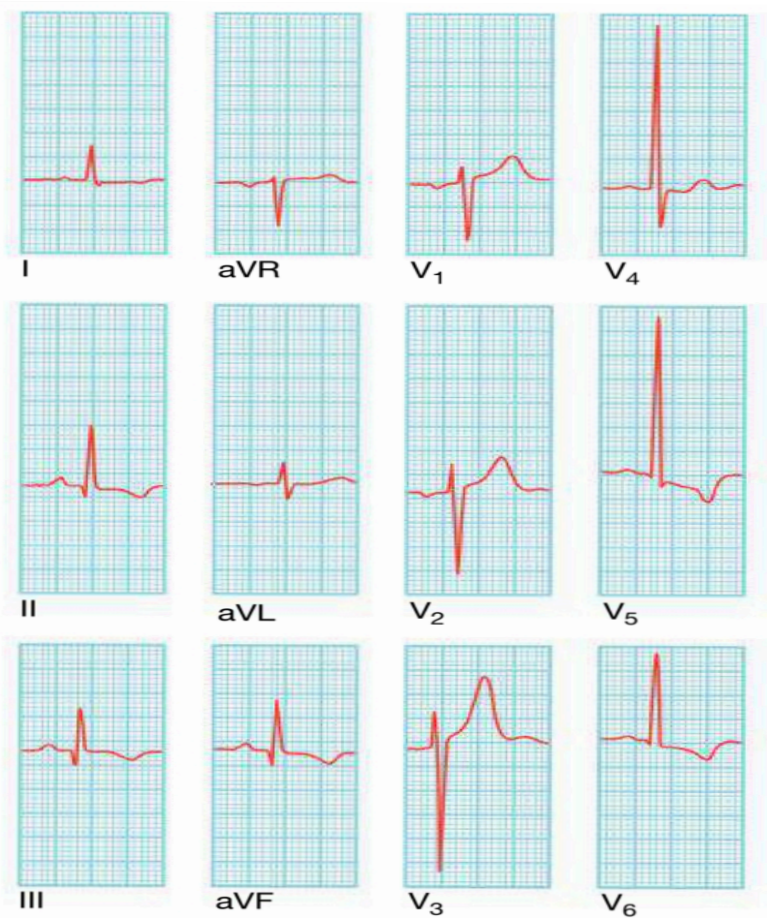


# ECG

## Left ventricular hypertrophy

**LV Strain – ST-segment depression and T-wave inversion in standard leads I and aVL and in the left precordial leads.**

**Occasionally, there is evidence of AV block due to the encroachment of the fibrocalcific process on the adjacent AV node and His–Purkinje system; an occasional cause of syncope in these patients.**



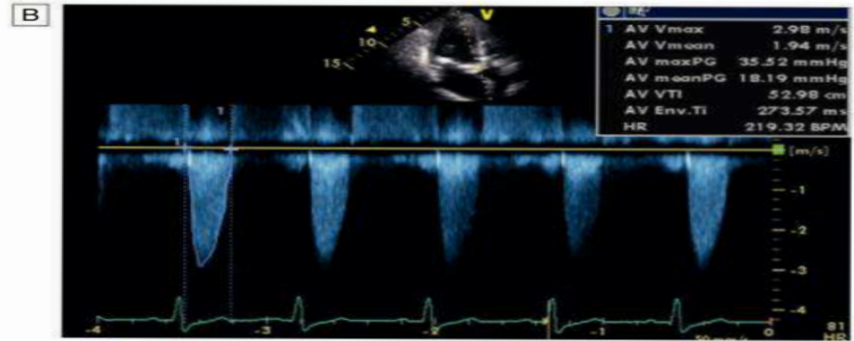
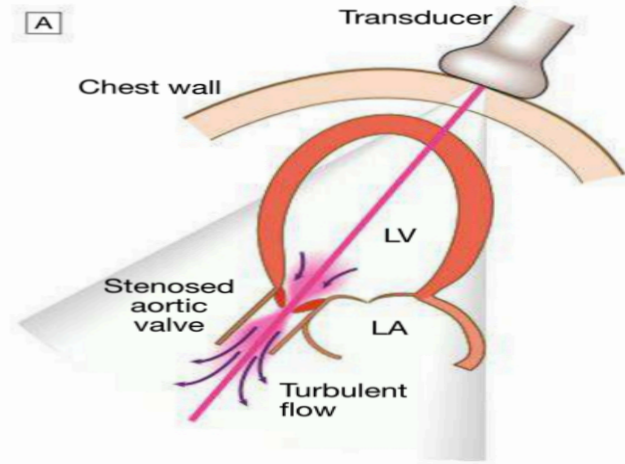
**Fig. 16.84 Left ventricular hypertrophy.** QRS complexes in limb leads have increased amplitude with very large R waves in V<sub>4</sub> and V<sub>5</sub> and a deep S wave in V<sub>3</sub>. There is ST depression and T-wave inversion in leads II, III, aVL, V<sub>5</sub> and V<sub>6</sub>: a 'left ventricular strain' pattern.

# Doppler

- Calculation of the systolic gradient across the aortic valve – assess severity of stenosis  
Detection of associated aortic regurgitation

## Cardiac Catheterisation

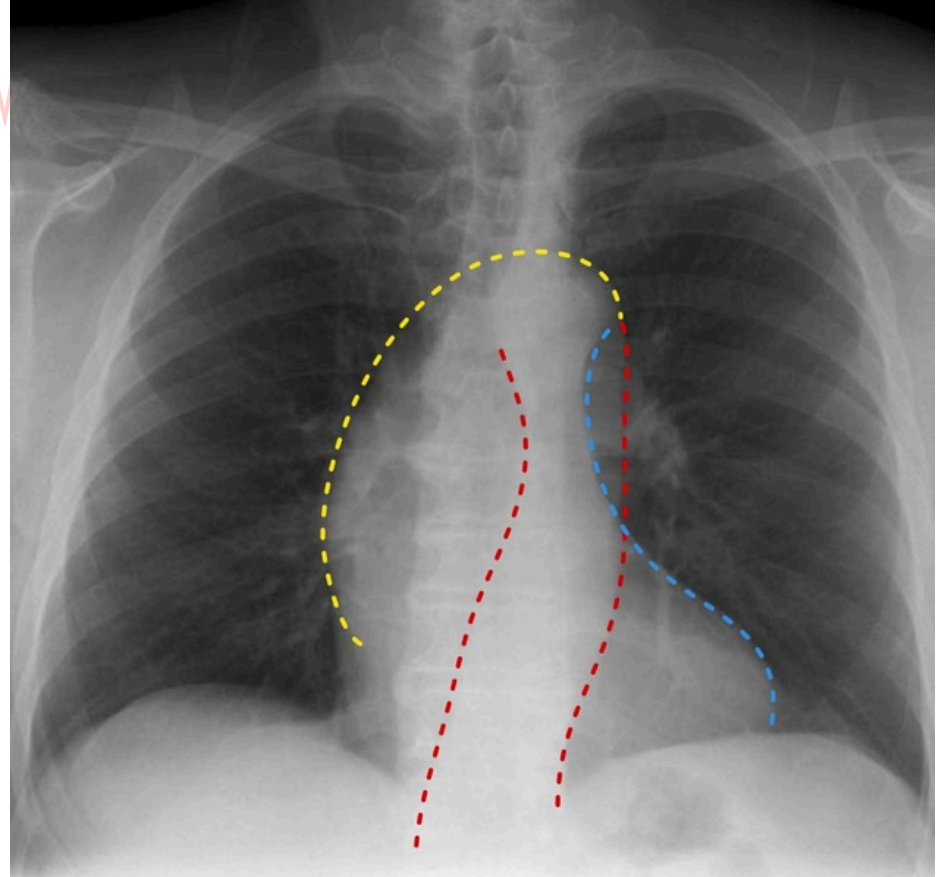
- Mainly to identify associated coronary artery disease  
May be used to measure gradient between left ventricle and aorta



**Fig. 16.11** Doppler echocardiography in aortic stenosis. **A** The aortic valve is imaged and a Doppler beam passed directly through the left ventricular outflow tract and the aorta into the turbulent flow beyond the stenosed valve. **B** The velocity of the blood cells is recorded to determine the maximum velocity and hence the pressure gradient across the valve. In this example, the peak velocity is approximately 450 cm/sec (4.5 m/sec), indicating severe aortic stenosis (peak gradient of 81 mmHg). (LA = left atrium; LV = left ventricle)

# Chest xray

- **Sometimes enlarged left ventricle**  
**dilated ascending aorta on PA view**  
**calcified valve on lateral view**



# MANAGEMENT



## ASYMPTOMATIC AS

Good immediate prognosis  
Conservative management  
is appropriate.

Development of angina,  
syncope, symptoms of low  
CO or heart failure –  
indication for surgery

## MODERATE AS

Should be evaluated every  
1–2 years with Doppler  
echocardiography to detect  
evidence of progression in  
severity.

More frequent evaluation  
(typically 3–6-monthly) in  
older patients with heavily  
calcified valves.

## SEVERE SYMPTOMATIC AS

Aortic valve  
replacement

Transcatheter aortic  
valve implantation

# Aortic Valve Replacement



- **Indications**
  - severe AS who are symptomatic**
  - LV systolic dysfunction**
  - AS due to BAV disease and an aneurysmal root or ascending aorta**

# TRANSCATHETER AORTIC VALVE IMPLANTATION

- It is most commonly performed using one of two systems, a balloon-expandable valve or self-expanding valve, both of which incorporate a pericardial bioprosthesis via the transfemoral route, Aortic balloon valvuloplasty is performed as a first step to create an orifice of sufficient size for the prosthesis. Procedural success rates exceed 95%

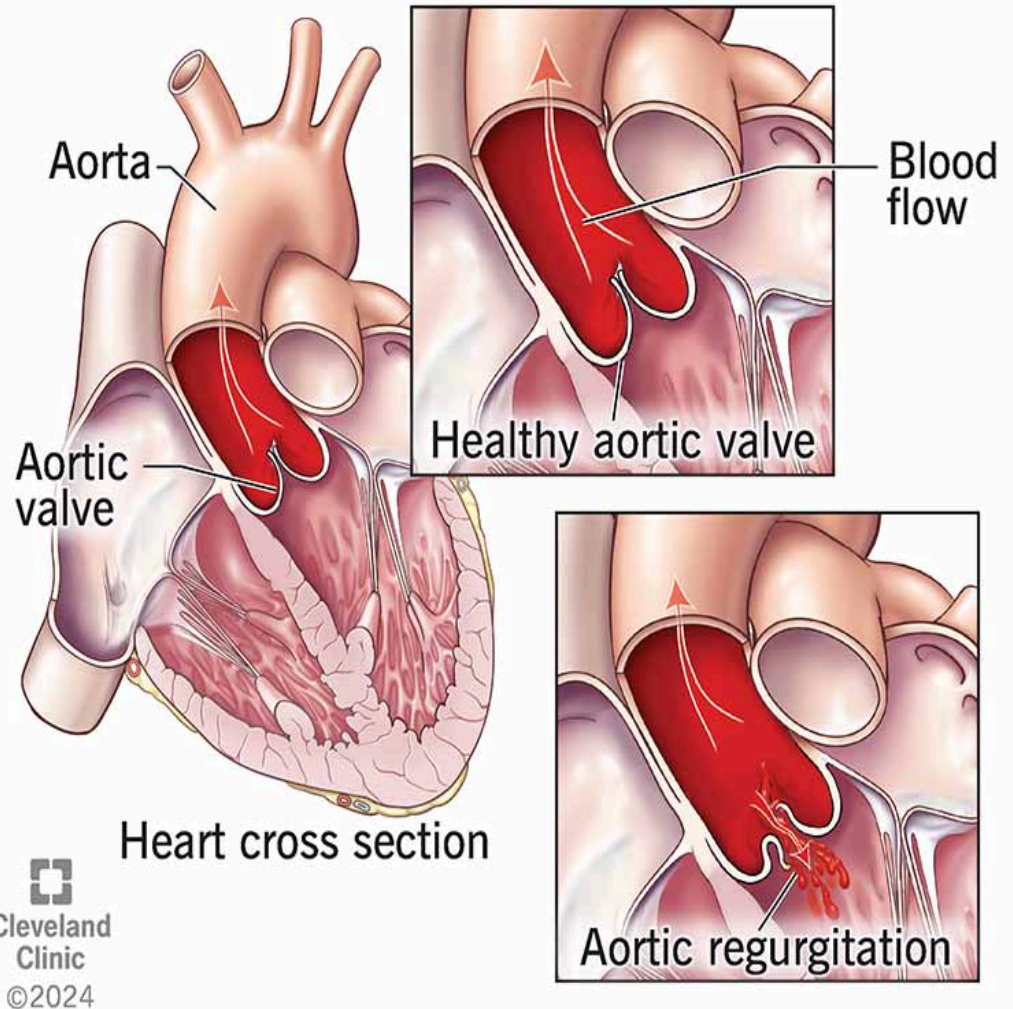




# AORTIC REGURGITATION



- It is an aortic valve disease that occurs when the aortic valve doesn't close properly



# i

## 16.88 Causes of aortic regurgitation

### Congenital

- Bicuspid valve or disproportionate cusps

### Acquired

- Rheumatic disease
- Infective endocarditis
- Trauma
- Causes of aortic dilatation:
  - Marfan syndrome
  - Aneurysm
  - Aortic dissection
  - Syphilis
  - Ankylosing spondylitis

Etiology



# Pathophysiology



1. Regurgitation of blood through the aortic valve causes the LV to dilate and there is eccentric hypertrophy of LV.

2. The stroke volume of the LV may eventually be doubled and the major arteries are then conspicuously pulsatile.

3. AR is a state in which LV preload and afterload are both increased.

4. As the disease progresses, LV failure develops

# Clinical features



## Symptoms

Mild to moderate  
Aortic  
regurgitation

Often asymptomatic  
Palpitations

Severe  
Aortic  
regurgitation

Paroxysmal nocturnal dyspnea  
Angina



# Clinical Signs

## 1. Pulse

1

### Water hammer /Corrigan's pulse

large volume and collapsing pulse

Low diastolic and increased pulse pressure

Bounding peripheral pulses

2

### De Musset's sign

Head nodding with pulse

3

### Quincke's pulse

an alternate flushing and paling of the skin at the root of the nail while pressure is applied to the tip of the nail

4

### Traube's sign

A booming pistol-shot sound can be heard over the femoral arteries

5

### Duroziez's sign

to-and-fro murmur which is audible if the femoral artery is lightly compressed with a stethoscope.



**Dancing  
Carotids**

*Water 💧 Hammer Pulse  
(Corrigan sign when  
present in Carotid artery)*

## Other Signs

Displaced, thrusting apex beat (volume overload)  
Pre-systolic impulse  
S3 and S4 heard  
Crepitations (pulmonary venous congestion)

## 2. Murmur



Early diastolic murmur

Lean the patient forward with breath held in expiration - left sternal border


Systolic murmur

(increased stroke volume)

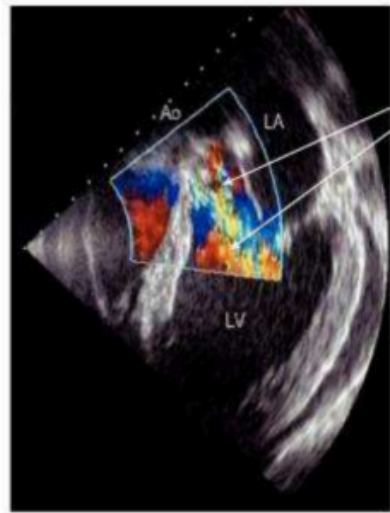
Austin flint murmur

Soft mid-diastolic murmur – due to fluttering and partial closure of MV.

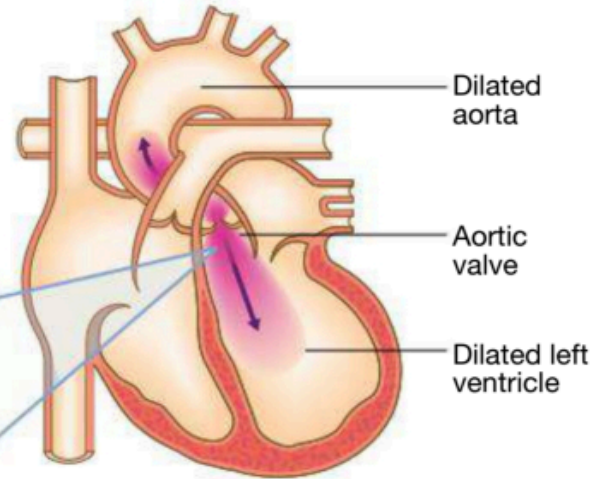
**CAN PRESENT WITH A  
BOUNDING PULSE  
OR  
WIDE PULSE PRESSURE**



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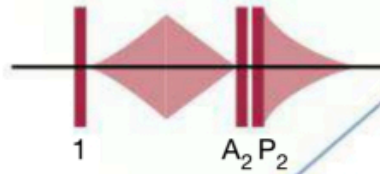
Colour jet of aortic regurgitation



Dilated aorta

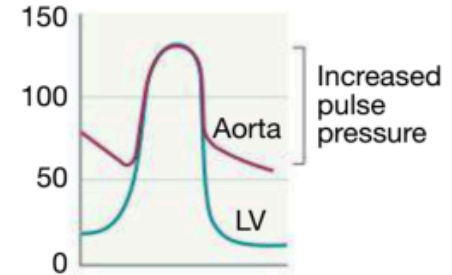
Aortic valve

Dilated left ventricle



Lean patient forward with breath held in expiration to hear early diastolic murmur best

mmHg



**Fig. 16.85 Aortic regurgitation.** The early diastolic murmur is best heard at the left sternal border and may be accompanied by an ejection systolic ('to-and-fro') murmur. The aortic arch and left ventricle (LV) may become dilated. The inset shows a Doppler echocardiogram with the regurgitant jet (arrows). *Inset (Colour Doppler echo) From Newby D, Grubb N. Cardiology: an illustrated colour text. Edinburgh: Churchill Livingstone, Elsevier Ltd; 2005.*

# INVESTIGATIONS



## CARDIAC CATHETERISATION

### ECG

### CHEST XRAY

### ECHOCARDIOGRAPHY

Dilated left ventricle  
Hyperdynamic left ventricle  
Doppler detects reflux  
Fluttering anterior mitral leaflet

Cardiac dilatation,  
maybe aortic dilatation  
Features of left heart failure

Left ventricular hypertrophy and T-wave inversion (LV strain)

Dilated left ventricle  
Dilated aortic root



# MANAGEMENT



## Asymptomatic patients

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Followed up annually with echocardiography

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If increasing ventricular size or the end-systolic dimension increases to 55 mm or more, then AVR should be done.

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## Symptomatic AR

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Aortic valve replacement and may need to be combined with aortic root replacement (when aortic root dilatation is the cause as in Marfan syndrome) and coronary bypass surgery.

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If systemic hypertension is present, vasodilators, such as nifedipine, should be used to control systolic BP

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# Questions



**1. Which of the following is the most common cause of aortic stenosis in elderly patients?**

- A) Rheumatic heart disease**
- B) Bicuspid aortic valve**
- C) Degenerative (calcific) aortic stenosis**
- D) Infective endocarditis**

**2. Which of the following auscultatory findings is characteristic of aortic stenosis?**

- A) Mid-diastolic murmur at the apex**
- B) Early diastolic murmur at the left sternal border**
- C) Systolic crescendo-decrescendo murmur at the right upper sternal border**
- D) Continuous murmur over the precordium**

**3. What is the most common congenital abnormality leading to aortic stenosis?**



- A) Unicuspid aortic valve**
- B) Tricuspid aortic valve**
- C) Bicuspid aortic valve**
- D) Quadricuspid aortic valve**

**4. Which of the following is NOT a feature of severe aortic stenosis?**

- A) Pulsus parvus et tardus**
- B) Left ventricular hypertrophy**
- C) Early peaking systolic murmur**
- D) Syncope on exertion**

**5. Which of the following is NOT a classic clinical sign of severe chronic aortic regurgitation?**

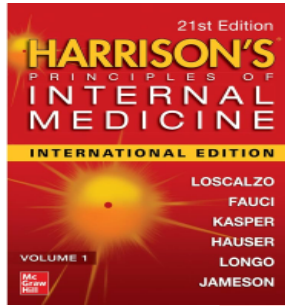


- A) Corrigan's pulse**
- B) De Musset's sign**
- C) Austin Flint murmur**
- D) Kussmaul's sign**

**6. Aortic regurgitation causes which pulse abnormality?**

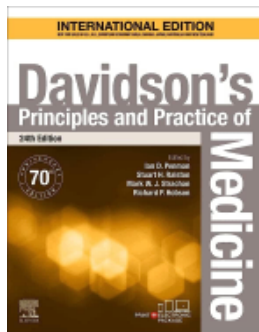
- A) Weak pulse**
- B) Water hammer pulse**
- C) Irregular pulse**
- D) Slow pulse**

# REFERENCES



## Harrison's Principles of Internal Medicine

21<sup>st</sup> Edition



## Davidson's Principles and Practices of Medicine-

24<sup>th</sup> Edition

