VALVULAR HEART DISEASE

By :

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AS : aortic valve stenosis
AR : aortic valve regurgitation

MS : mitral valve stenosis
MR : mitral valve regurgitation

PS : pulmonary valve stenosis
PR : pulmonary valve regurgitation

TS : tricuspid valve stenosis
TR : tricuspid valve regurgitation

RHF : right sided heart failure
LHF : left sided heart failure .

LVH : left ventricular hypertrophy
RVH : right ventricular hypertrophy

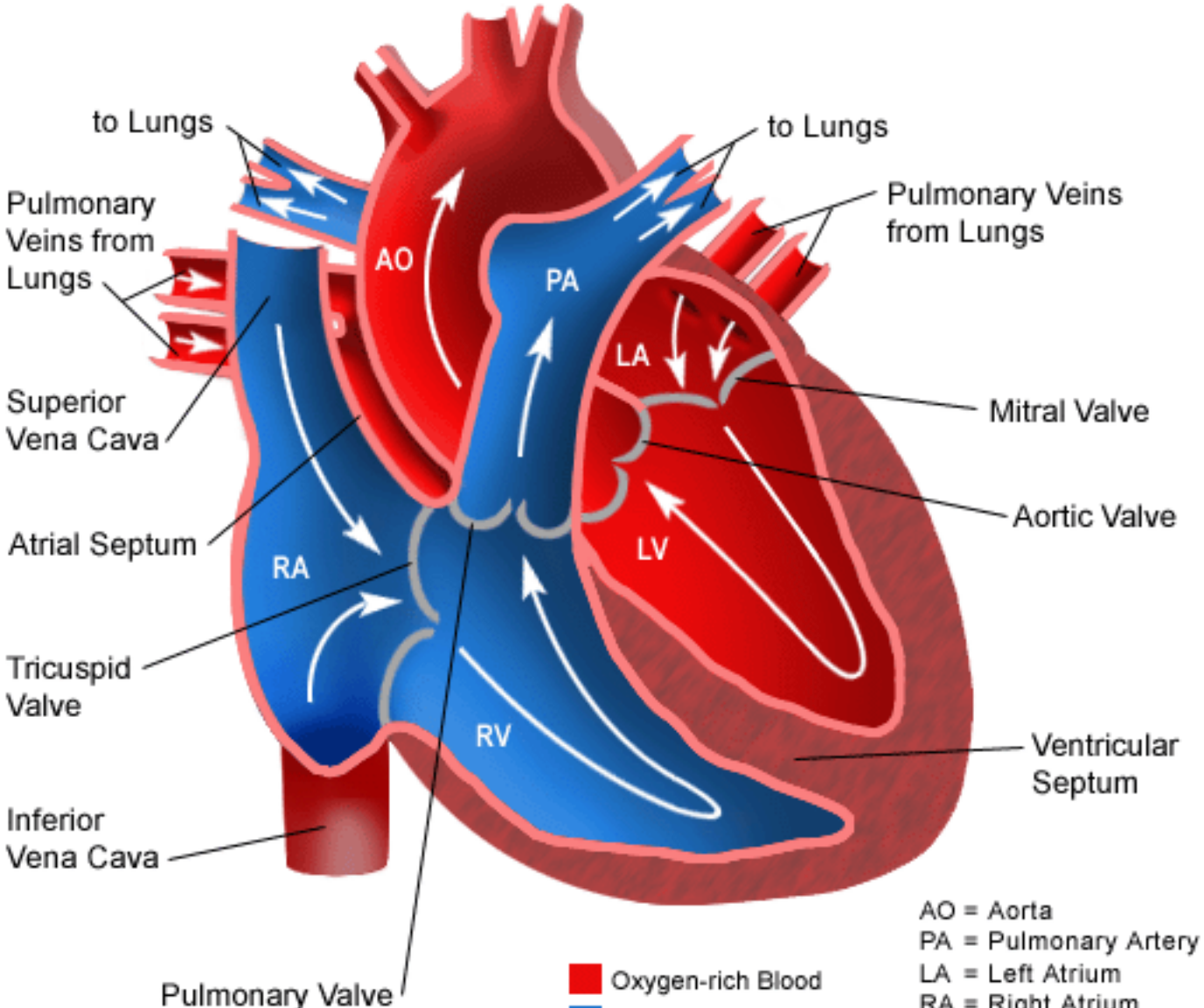
PH : pulmonary hypertension

HFrEF: Hear failure with reduced ejection fraction

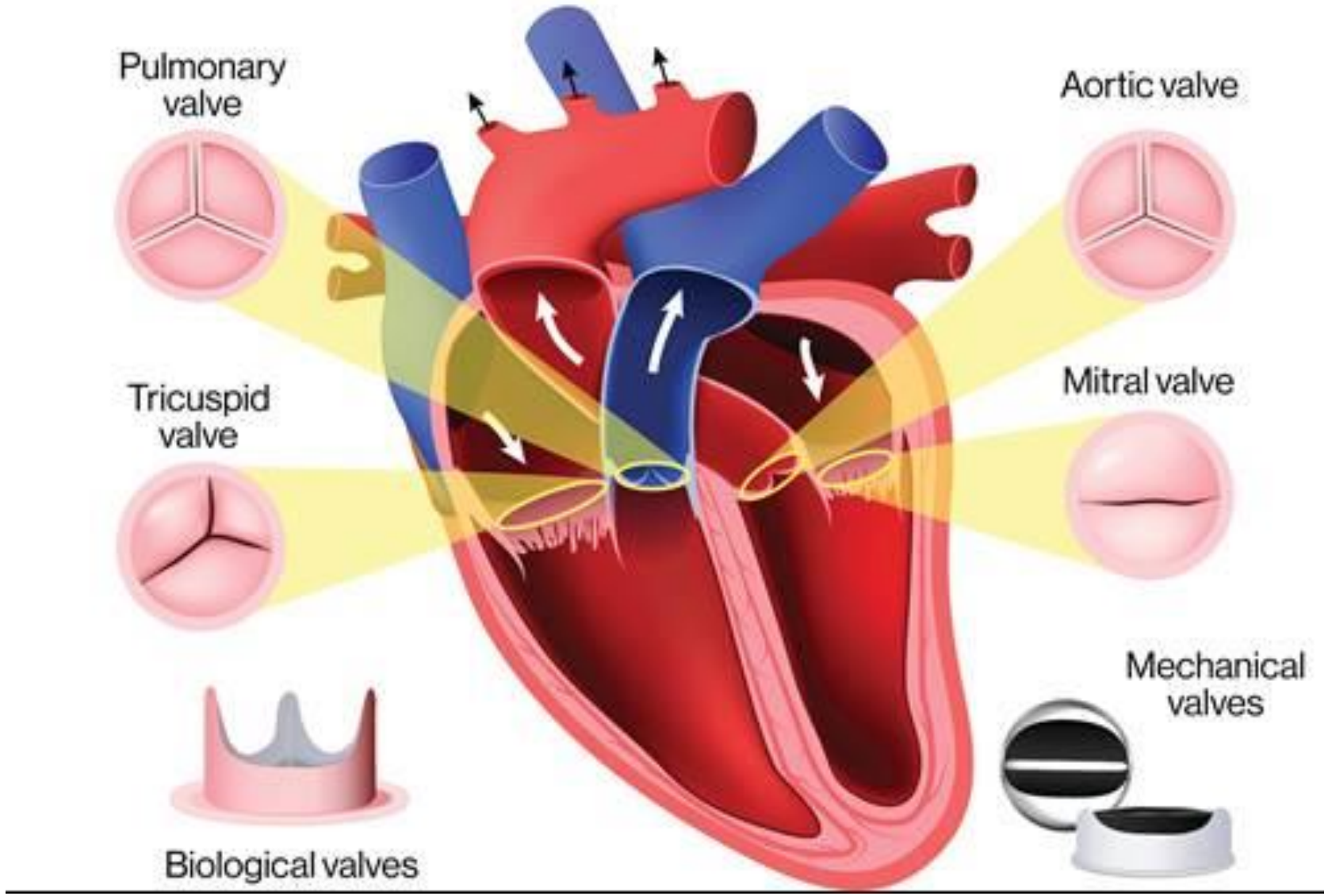
DOAC : Direct acting oral anticoagulant
VKA: Vitamin K antagonist

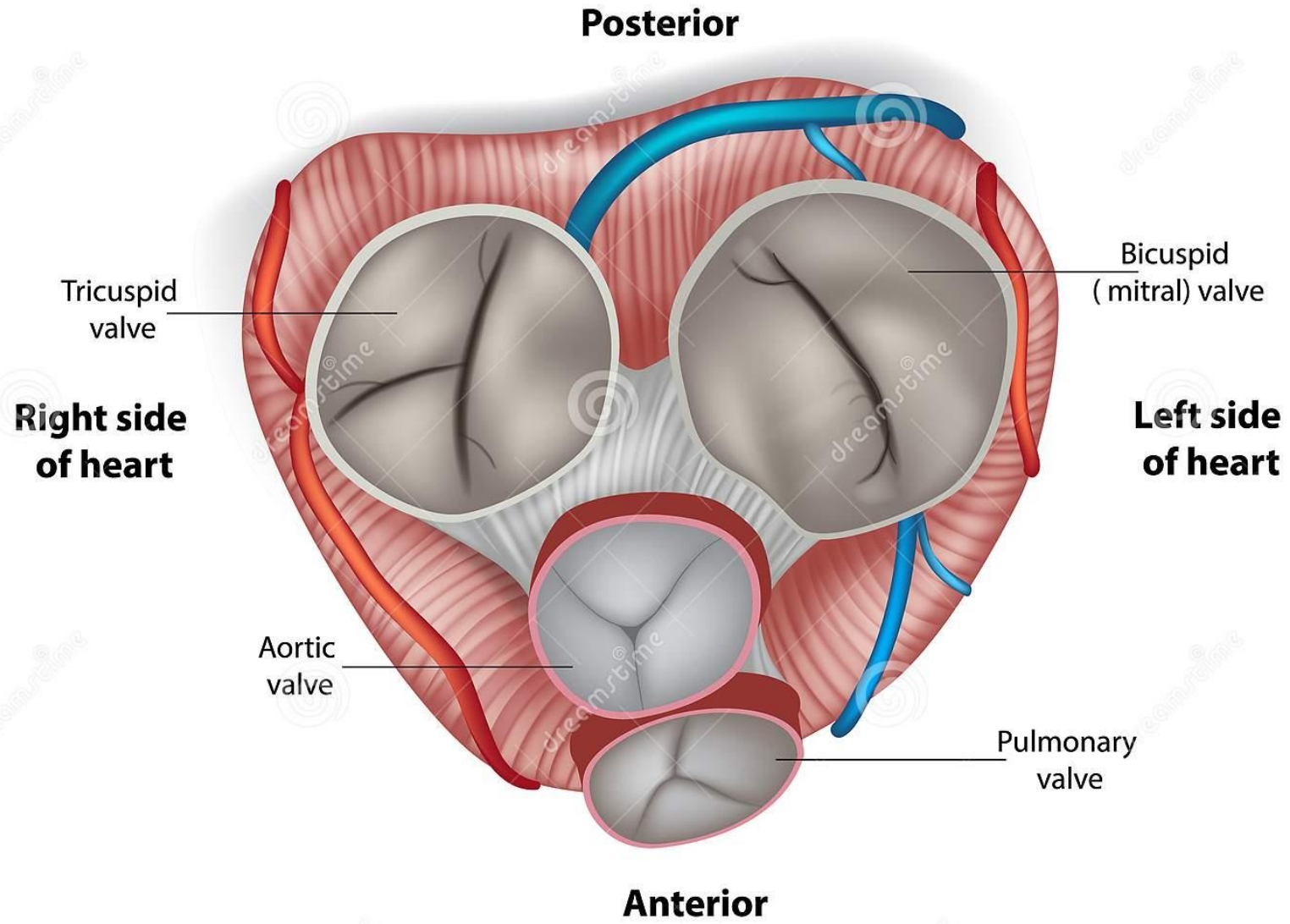
TAVI : Transcatheter aortic valve implanation

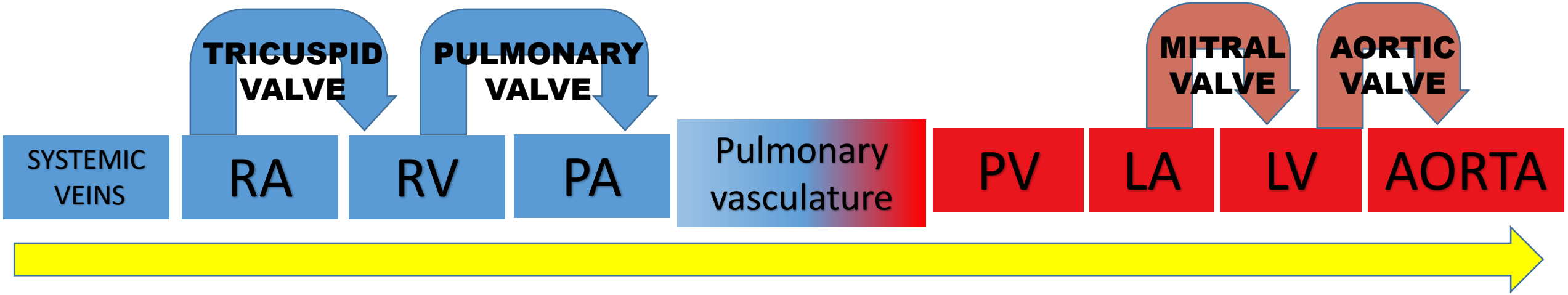
Normal Heart



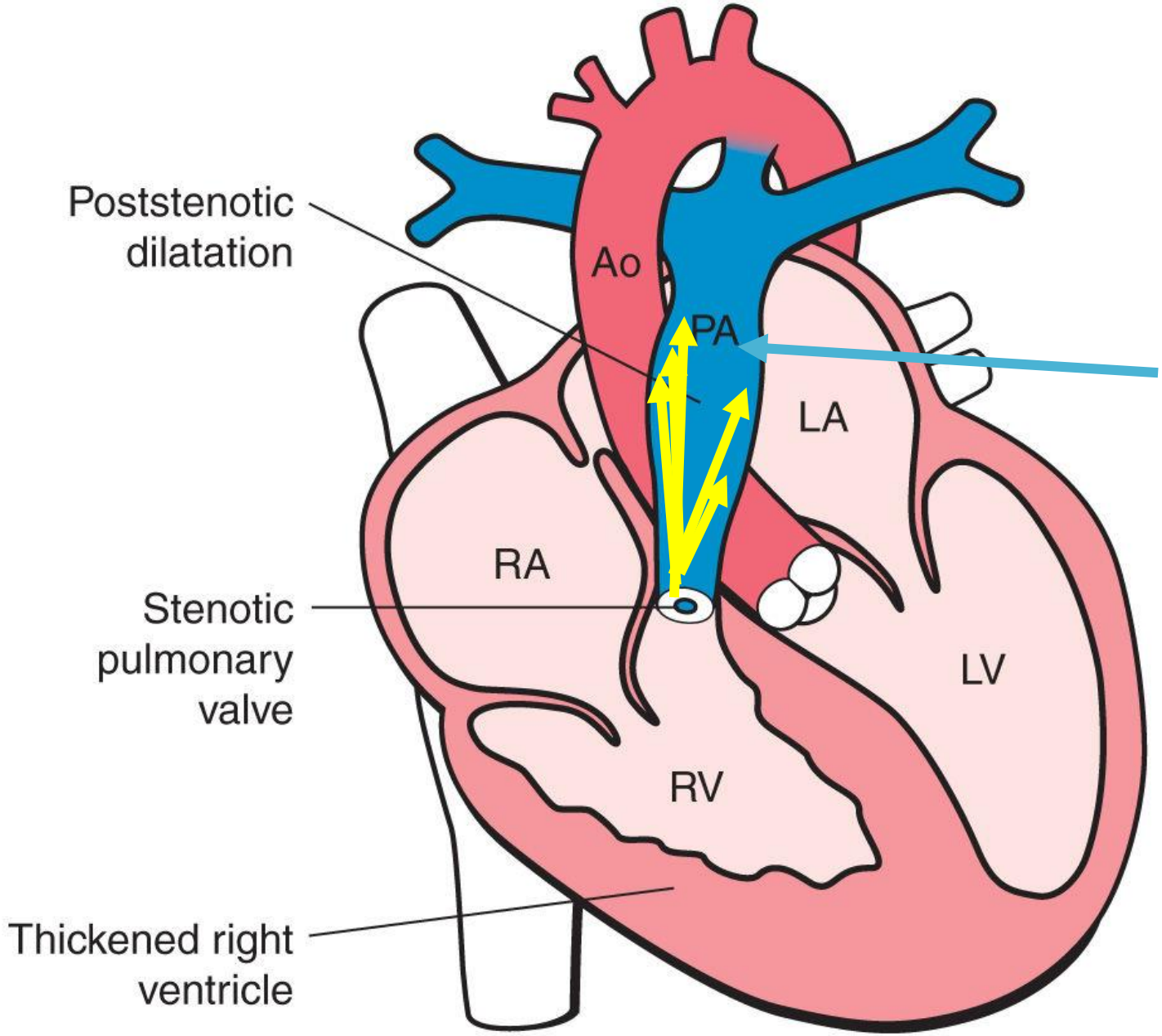
Heart valve


Pulmonary valve
Aortic valve
Tricuspid valve
Mitral valve
Mechanical valves
Biological valves





Valve stenosis (pressure overload)	
Severe MS , TS	↑ pressure in the preceding champers
severe AS , PS	↑ pressure in the preceding champers Fast jets can impact (aorta , PA) wall : post-stenotic dilatation
Valve regurgitation (volume overload)	
Severe MR , TR	↑ volume > pressure in preceding chambers ↑ volume in the following chamber
Severe AR	↑ volume > pressure in preceding chambers ↑ Volume to aorta and peripheral arteries (AR peripheral signs)

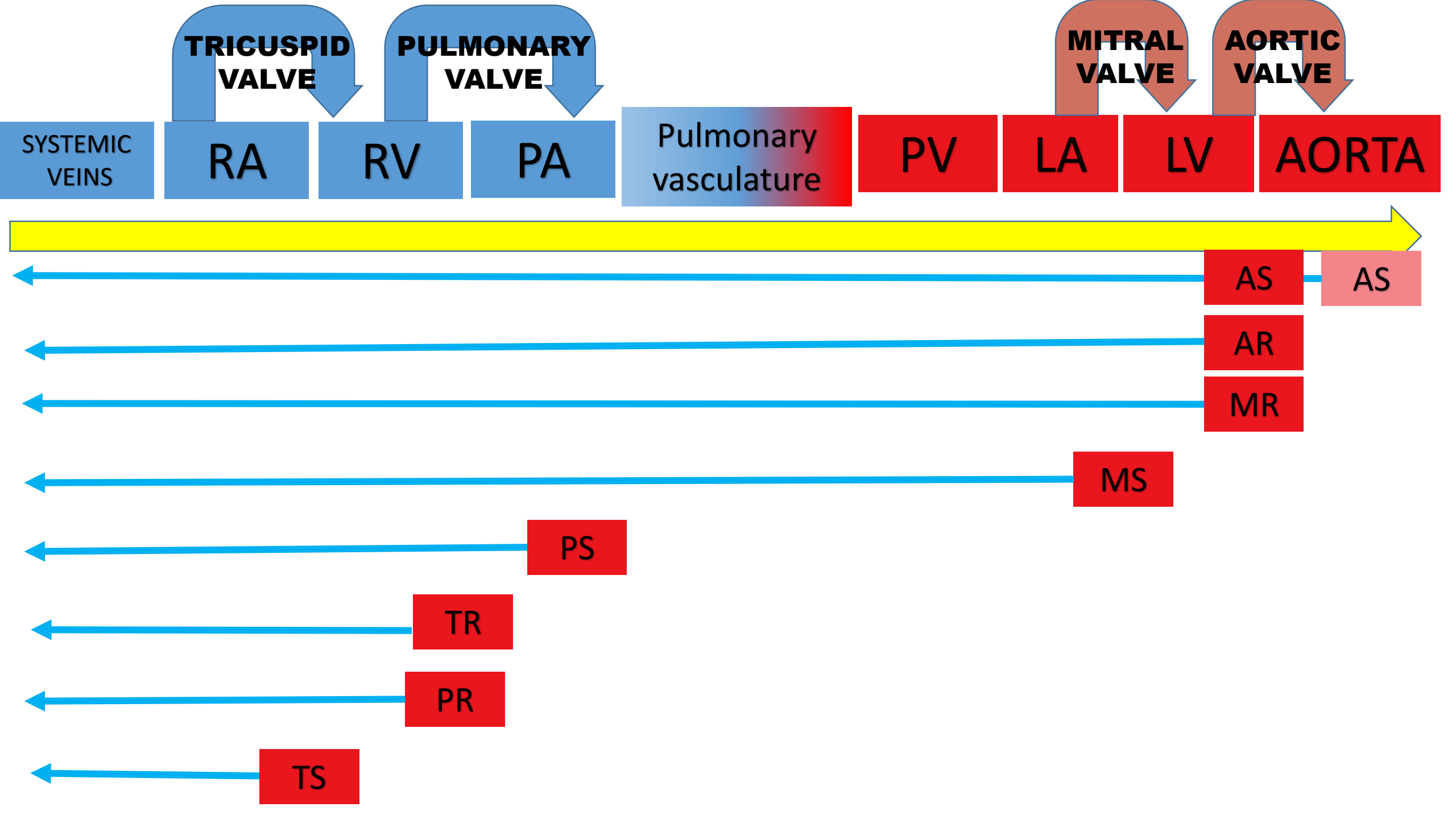


Post-stenotic dilatation

Mechanism:

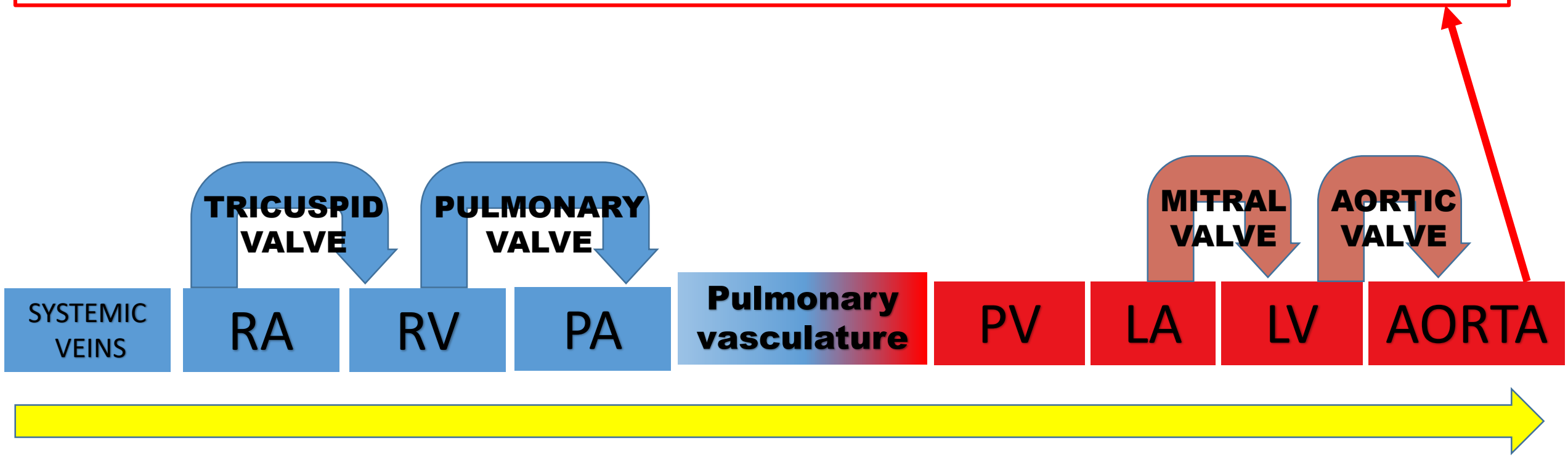
The impact of the fast jet on the arterial wall

Congenital severe PS , AS


TRICUSPID VALVE
PULMONARY VALVE
MITRAL VALVE
AORTIC VALVE
SYSTEMIC VEINS
RA
RV
PA
Pulmonary vasculature
PV
LA
LV
AORTA
AS
AS
AR
MR
MS
PS
TR
PR
TS

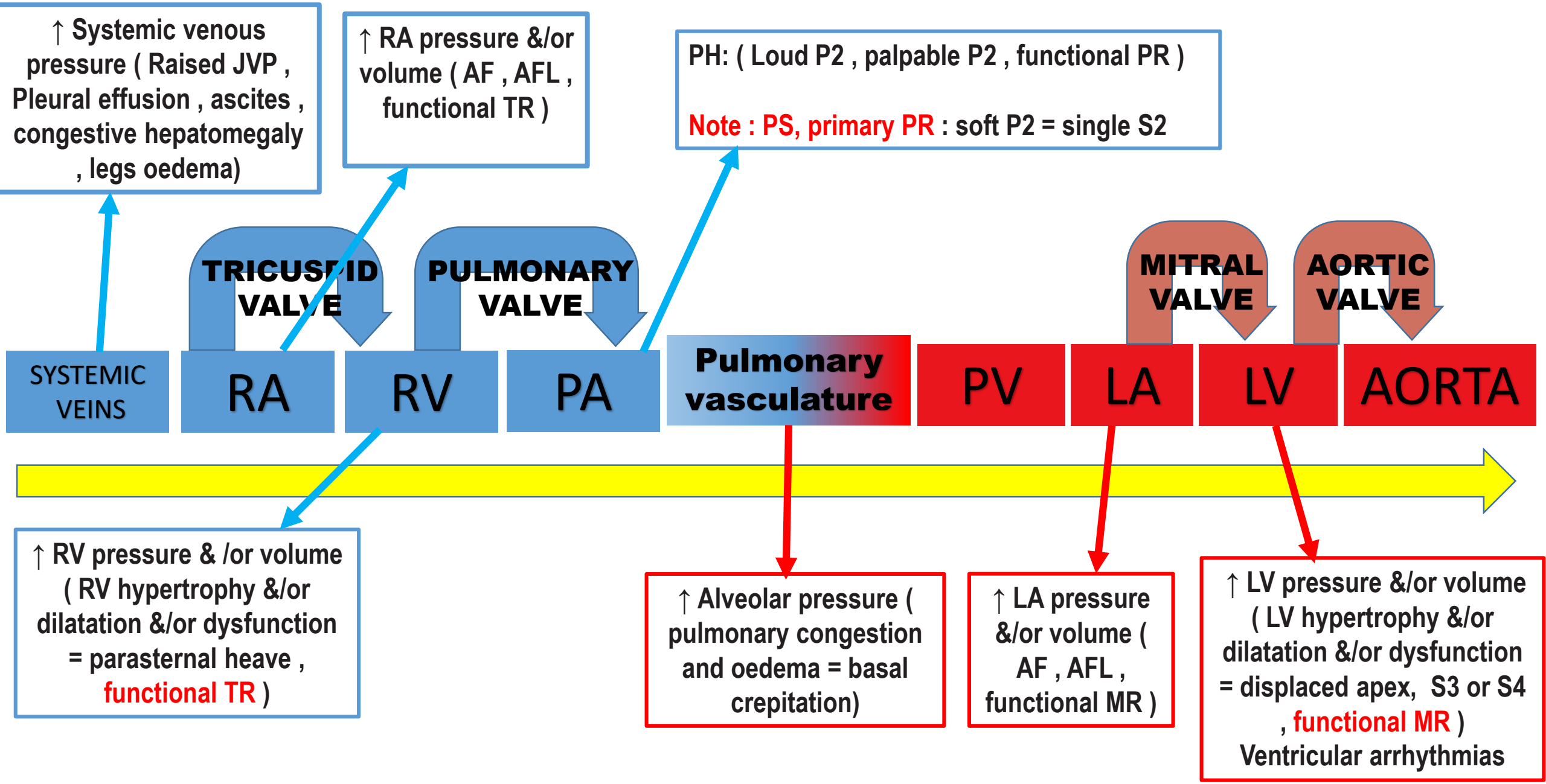
Aortic root dilatation :

- It can be the **the cause** of aortic regurgitation (**AR due to aortic root disease**) : e.g Marfan syndrome
- It **results** from Post-stenotic dilatation (impact of the jet on the aortic wall) : variable ; **not related to severity of AS** ; more in younger age patients (especially congenital and bicuspid AS)
- It **associates** with some cases of bicuspid aortic valve disease (genetic aortic root dilatation) and degenerative aortic valve disease (atherosclerotic aortic root dilatation)



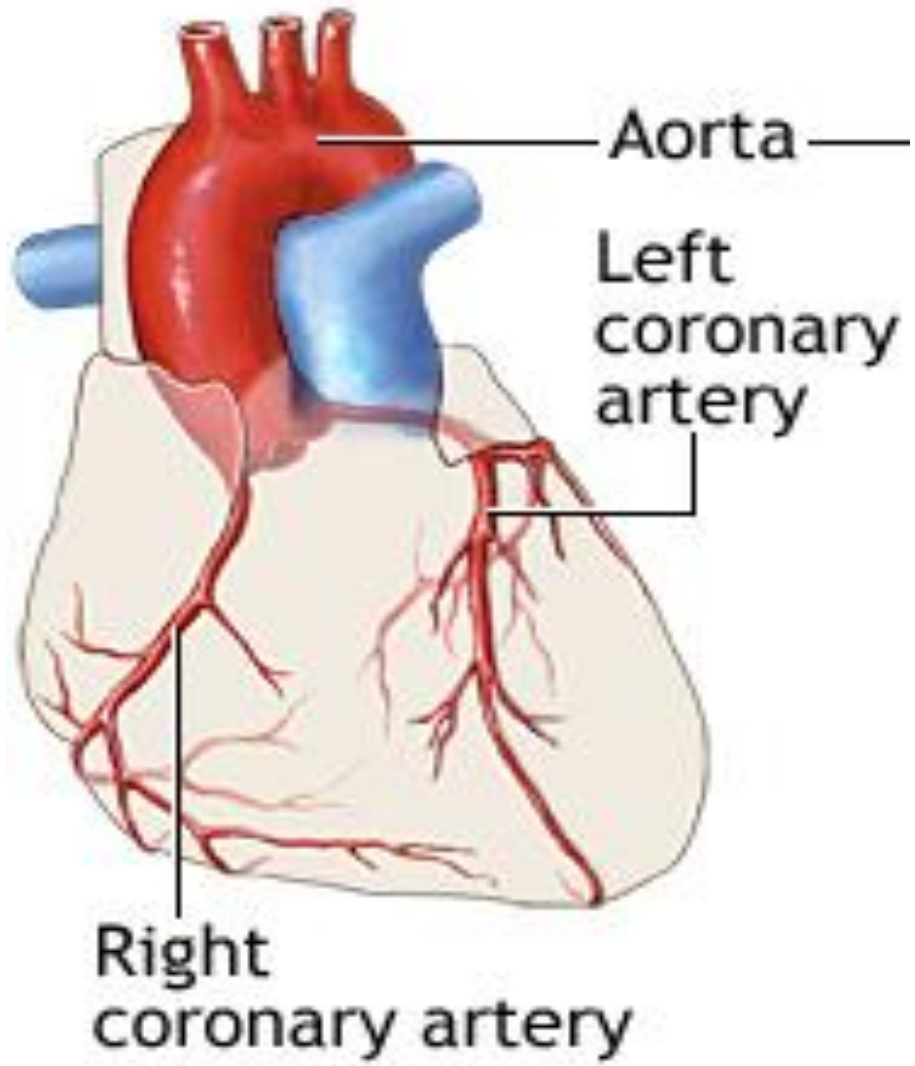
Enlarged chamber (clinical , ECG , CXR , Echocardiography)

	Aorta	LV	LA	PA	RV	RA
AR	- (+)(++)	++	+	+	+	+
AS	-(+)(++)	++	+	+	+	+
Primary MR		++	++	+(++)	+	+
MS			++	++	+	+
PS				++	++	+
PR					++	+
Primary TR					++	++
TS						++


↑ Systemic venous pressure (Raised JVP , Pleural effusion , ascites , congestive hepatomegaly , legs oedema)
↑ RA pressure &/or volume (AF , AFL , functional TR)
PH: (Loud P2 , palpable P2 , functional PR)
Note : PS, primary PR : soft P2 = single S2
TRICUSPID VALVE
PULMONARY VALVE
MITRAL VALVE
AORTIC VALVE
SYSTEMIC VEINS
RA
RV
PA
Pulmonary vasculature
PV
LA
LV
AORTA
↑ RV pressure & /or volume (RV hypertrophy &/or dilatation &/or dysfunction = parasternal heave , functional TR)
↑ Alveolar pressure (pulmonary congestion and oedema = basal crepitation)
↑ LA pressure &/or volume (AF , AFL , functional MR)
↑ LV pressure &/or volume (LV hypertrophy &/or dilatation &/or dysfunction = displaced apex, S3 or S4 , functional MR) Ventricular arrhythmias

Symptom	Cause
Asymptomatic	
Chest pain	AS , PH : (exertional)
Palpitation	Arrhythmias (atrial fibrillation, ventricular arrhythmias with ventricular dysfunction)
Syncope	Low cardiac output (severe stenosis) : exertional , arrhythmias
Fatigue	Low cardiac output (severe stenosis , ventricular dysfunction)
Breathlessness	Pulmonary congestion (left sided valvular disease)
Cough	Pulmonary congestion (left sided valvular disease)
Haemoptysis	Pulmonary congestion (left sided valvular disease) ; most common with severe MS
Oedema	RHF
Thromboembolism	Atrial fibrillation (most common with mitral valve disease especially MS)
Sudden death	severe AS , Ventricular arrhythmias (ventricular dysfunction)

Normal heart



Signs:

- **Mitral facies** :Severe mitral stenosis

- **Abnormal pulse** :
  - Small volume pulse (severe MS)
  - Small volume and slow rising (pulsus parvus et tardus) (severe AS)
  - Large volume pulse (severe MR)
  - large volume and collapsing (severe AR)
  - Bisference pulse (two systolic peaks) (severe AR or mixed AR and AS)

- **Abnormal BP** :
  - Hypertension : Coarctation of aorta (associated with bicuspid aortic valve that can cause AS , AR or mixed AS and AR) ; systemic hypertension associated with degenerative aortic valve disease
  - Hypotension & /or shock : advanced left or right ventricular failure
  - Wide pulse pressure : severe AR
  - Narrow pulse pressure : severe AS

- **Ankles oedema and raised JVP**: RHF

- **Abnormal Apex beat**

  Displaced apex beat :

  LV pressure overload (severe AS): laterally , thrusting sustained

  LV volume overload (severe AR , severe MR) : downward and laterally : thrusting non sustained

  Tapping apex : MS

- **Thrill (systolic) = Grade VI murmur : severe MR , severe AS , severe TR , severe PS**

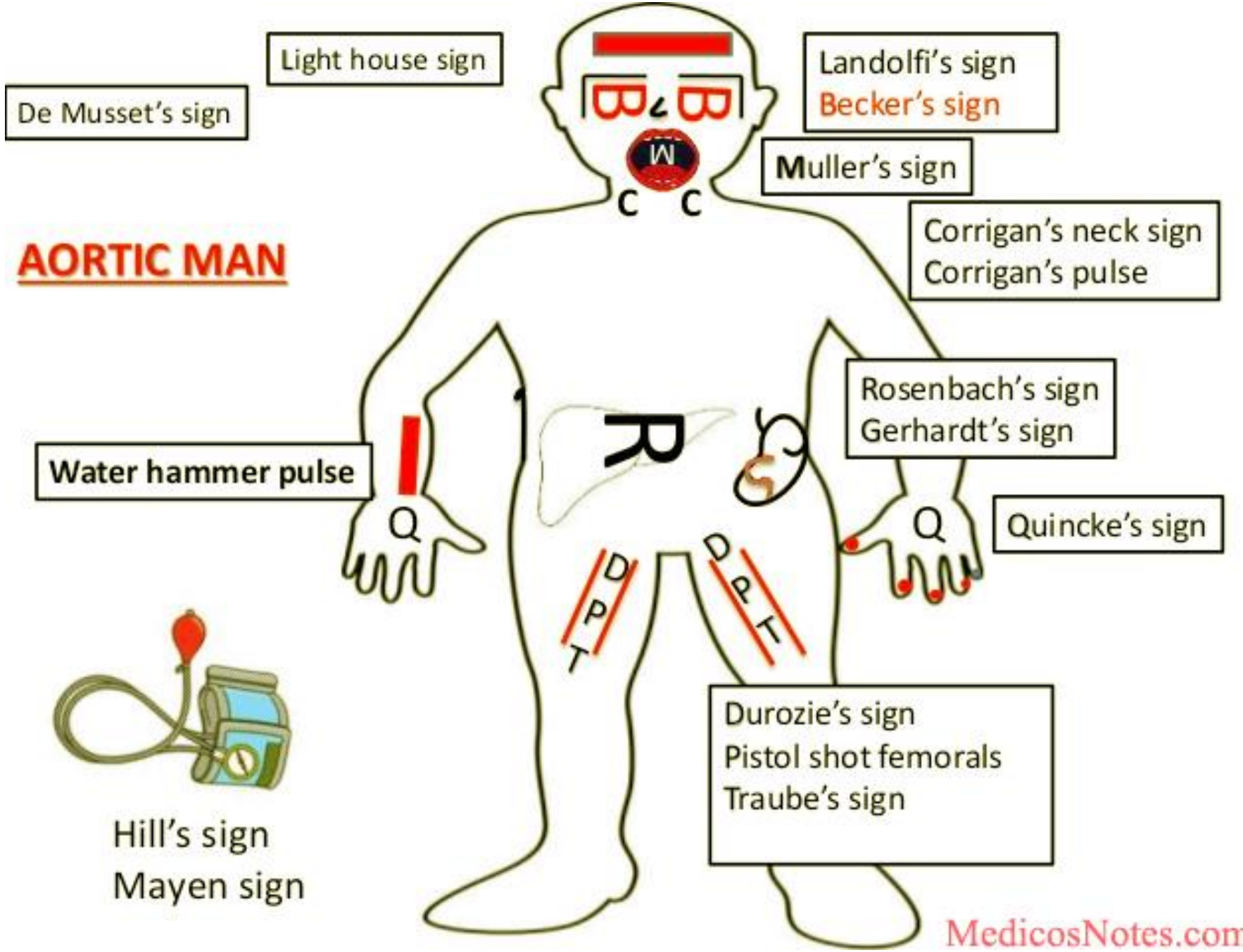
- **Parasternal Heave (RV dilatation or hypertrophy): PH (severe left-sided valvular disease) , severe PS , severe PR , Severe TR . Except ?**

Peripheral Signs of AR

They are due to the high-flow state, large stroke volume and wide pulse pressure

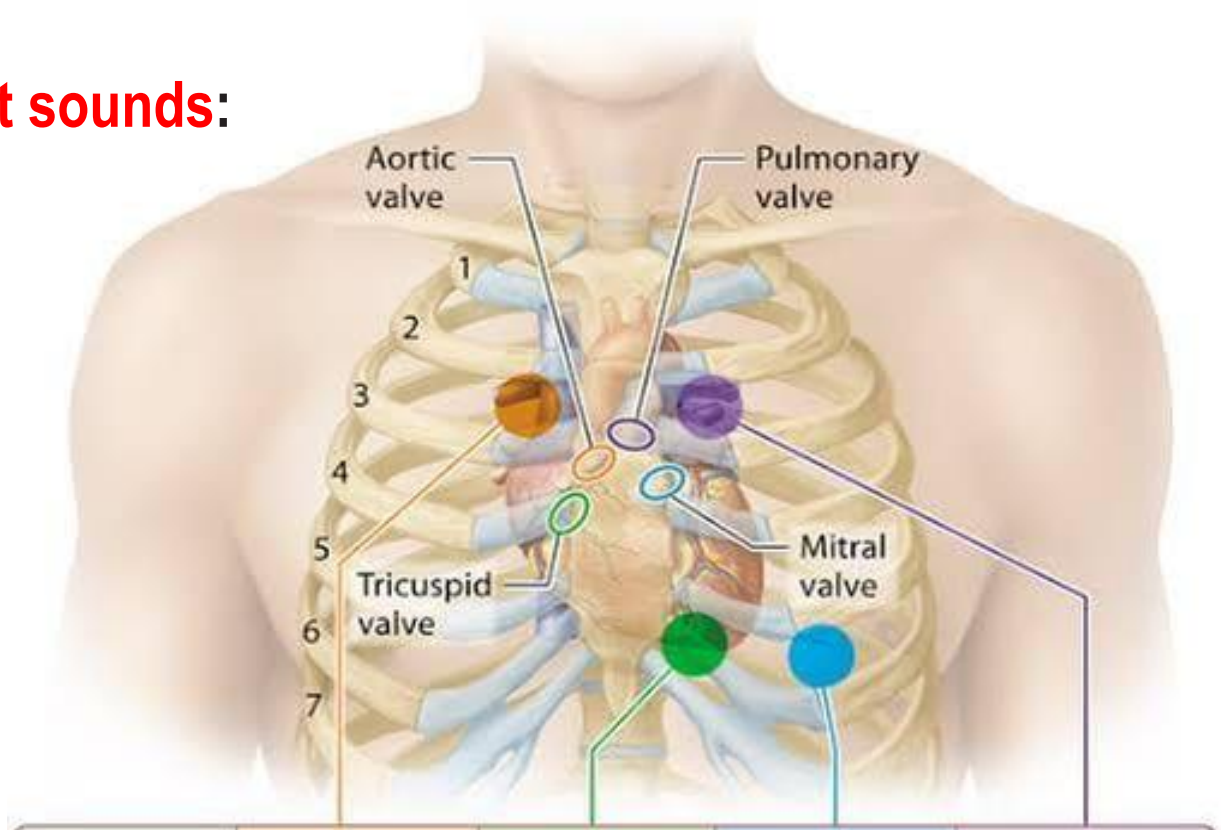
- **De Musset's sign**: Bobbing of the **head** with each heartbeat (like a bird walking)
- **Becker's sign**: Visible pulsation of the **retinal** arterioles
- **Landolfi's sign**: Systolic contraction and diastolic dilation of the **pupil**
- **Muller's sign**: Visible pulsations of the uvula
- **Corrigan's pulse**: A rapid and forceful distension of the **caroted** pulse with a quick collapse
- **Water hammer pulse** : a bounding pulse with rapid systolic rising and diastolic collapse that can be appreciated at either the **radial, ulnar or brachial artery**.
- **Quincke's sign**: Capillary pulsations seen on light compression of the **nail bed**
- **Traube's sign**: Systolic and diastolic sounds heard over the **femoral artery** ("pistol shots")
- **Duroziez's sign**: Gradual pressure over the **femoral artery** leads to a systolic and diastolic bruit
- **Hill's sign**: Popliteal systolic **blood pressure** exceeding brachial systolic blood pressure 60 mm Hg or more (most sensitive sign for aortic regurgitation)
- **Mayne's sign**: A decrease in diastolic **blood pressure** of 15 mmHg when the arm is held above the head (very non-specific)
- **Rosenbach's sign**: **Hepatic** pulsations
- **Gerhardt's sign (aka Sailer's sign)**: Pulsation of the **spleen** in the presence of splenomegaly

AORTIC MAN


Light house sign
De Musset's sign
Landolfi's sign
Becker's sign
Muller's sign
Corrigan's neck sign
Corrigan's pulse
Rosenbach's sign
Gerhardt's sign
Water hammer pulse
Quincke's sign
Durozie's sign
Pistol shot femorals
Traube's sign
Hill's sign
Mayen sign
MedicosNotes.com

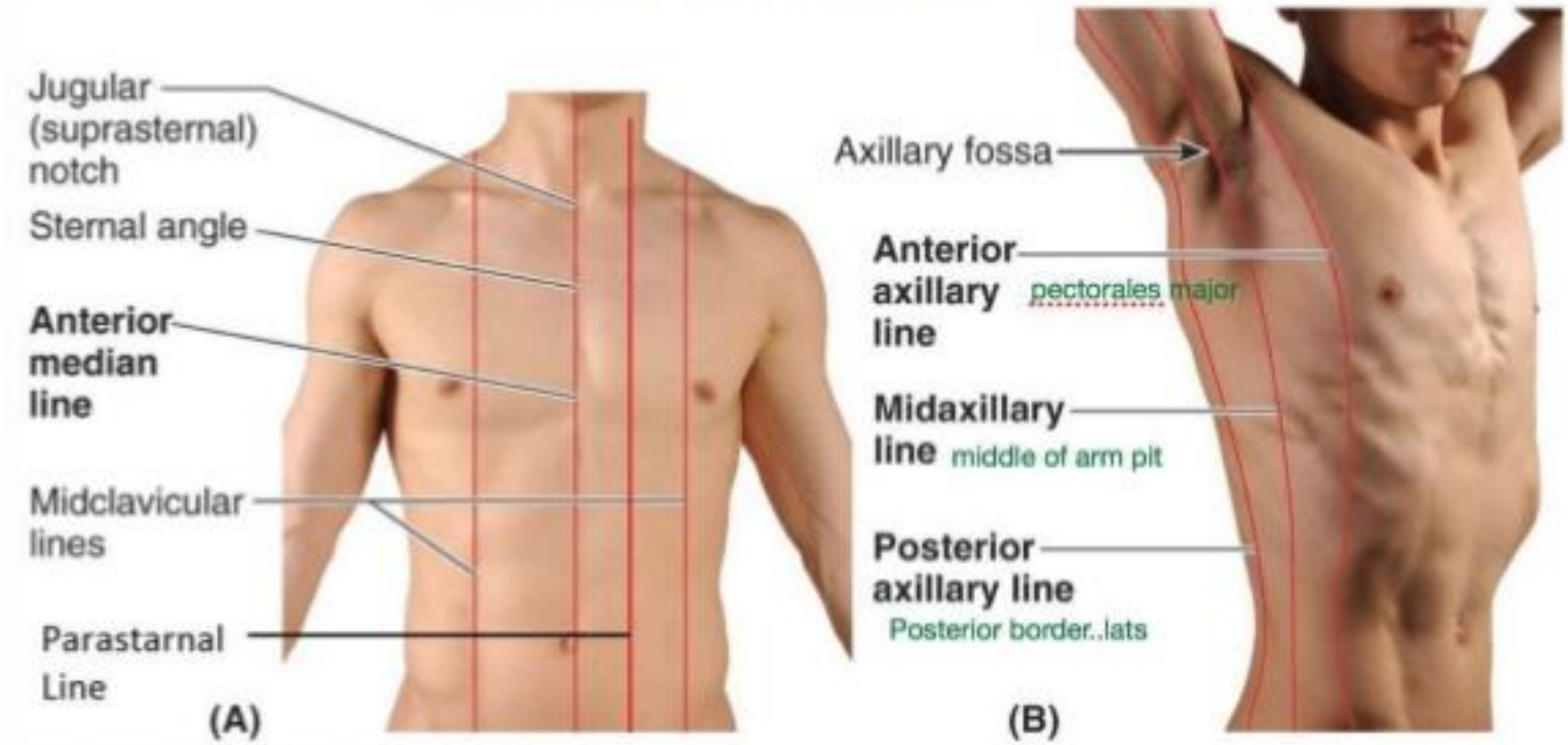
Mitral Facies

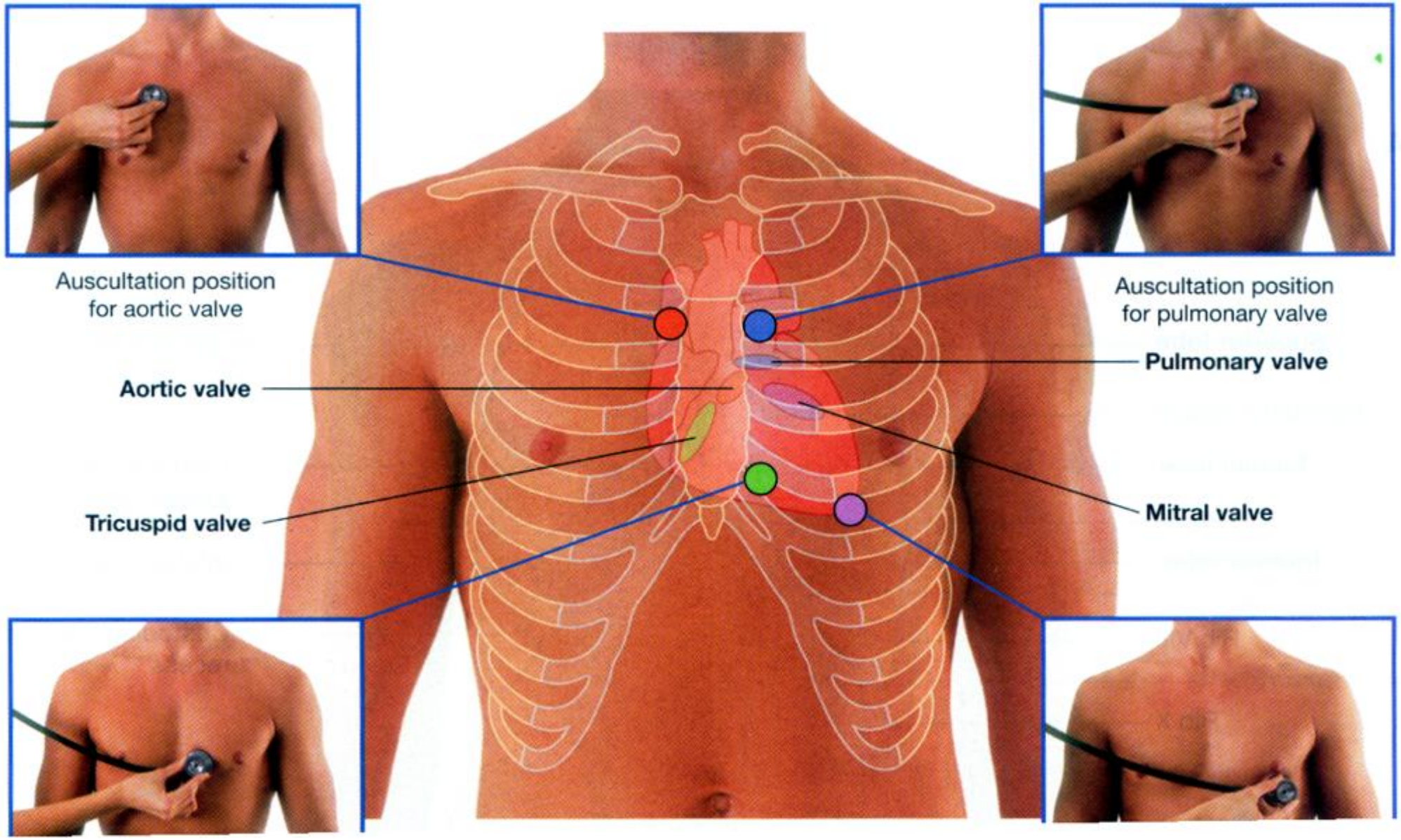
- **Abnormal heart sounds**:



AREA	Aortic	Tricuspid	Mitral	Pulmonary
LOCATION OF SOUND	Second intercostal space, right sternal border	Fifth intercostal space, left sternal border	Fifth intercostal space, mid-clavicular line	Second intercostal space, left sternal border
TIMING OF SOUND	Aortic valve is heard here during S2.	Tricuspid valve is heard here during S1.	Mitral valve is heard here during S1.	Pulmonary valve is heard here during S2.

Different Lines




Auscultation position for aortic valve
Auscultation position for pulmonary valve
Aortic valve
Pulmonary valve
Tricuspid valve
Mitral valve

S4 :
Severe AS
HT

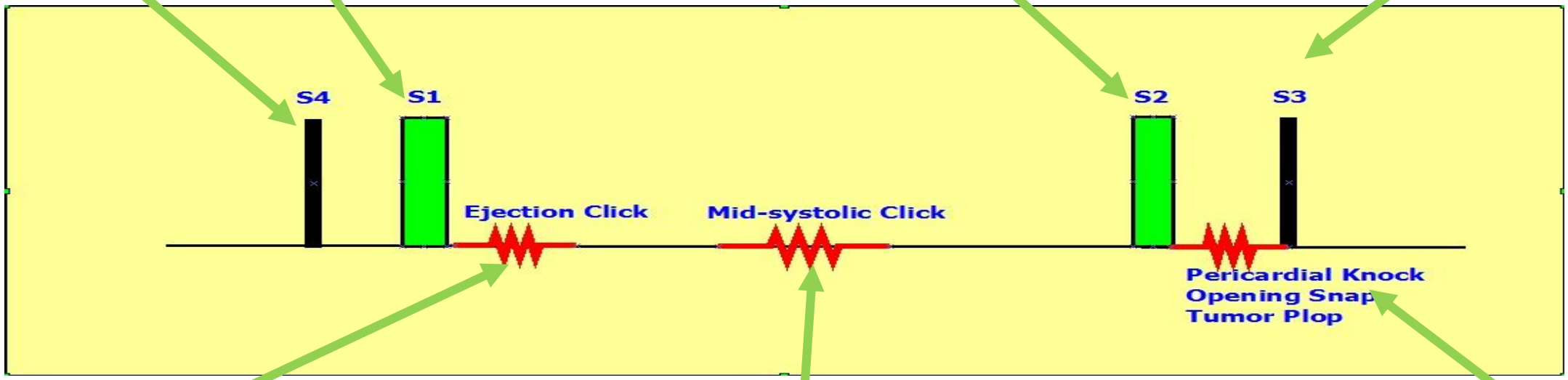
Soft S1 :
severe MR
Rare in extremely calcified MS

Soft A2 :
severe AS , severe AR

Loud P2 :
PH (severe left valvular disease)
Soft P2 : severe PS , PR

S3 :
- severe MR
- Left ventricular dysfunction

Result from severe : AS, AR, MR
Cause of secondary MR



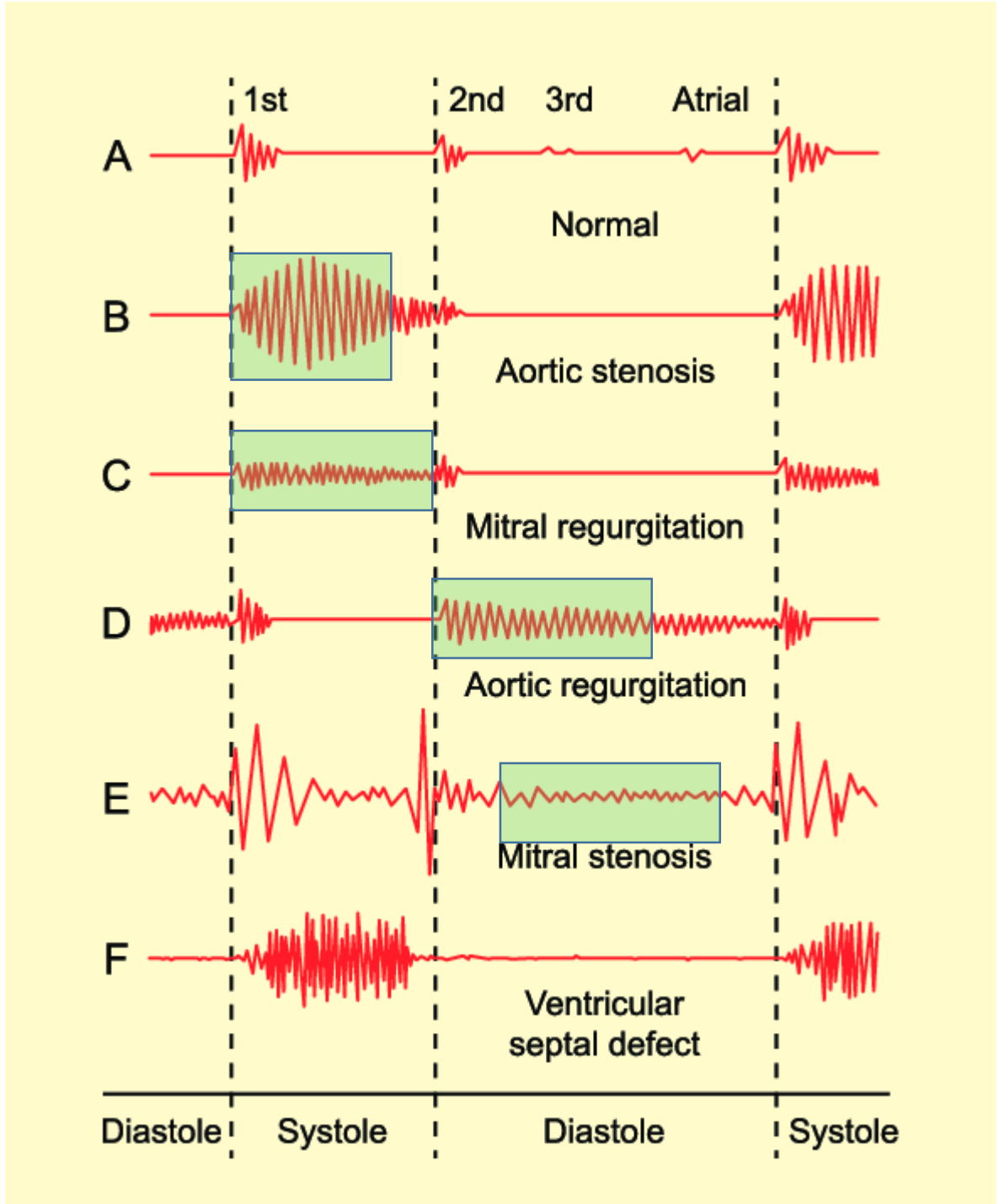
Ejection click :
Bicuspid aortic valve
Pulmonary stenosis

Mid systolic click :
Mitral valve prolapse
Closer to S1 (longer murmur) in severe prolapse

Opening snap : MS (except heavily calcified)
Earlier and closer to S2 in severe MS

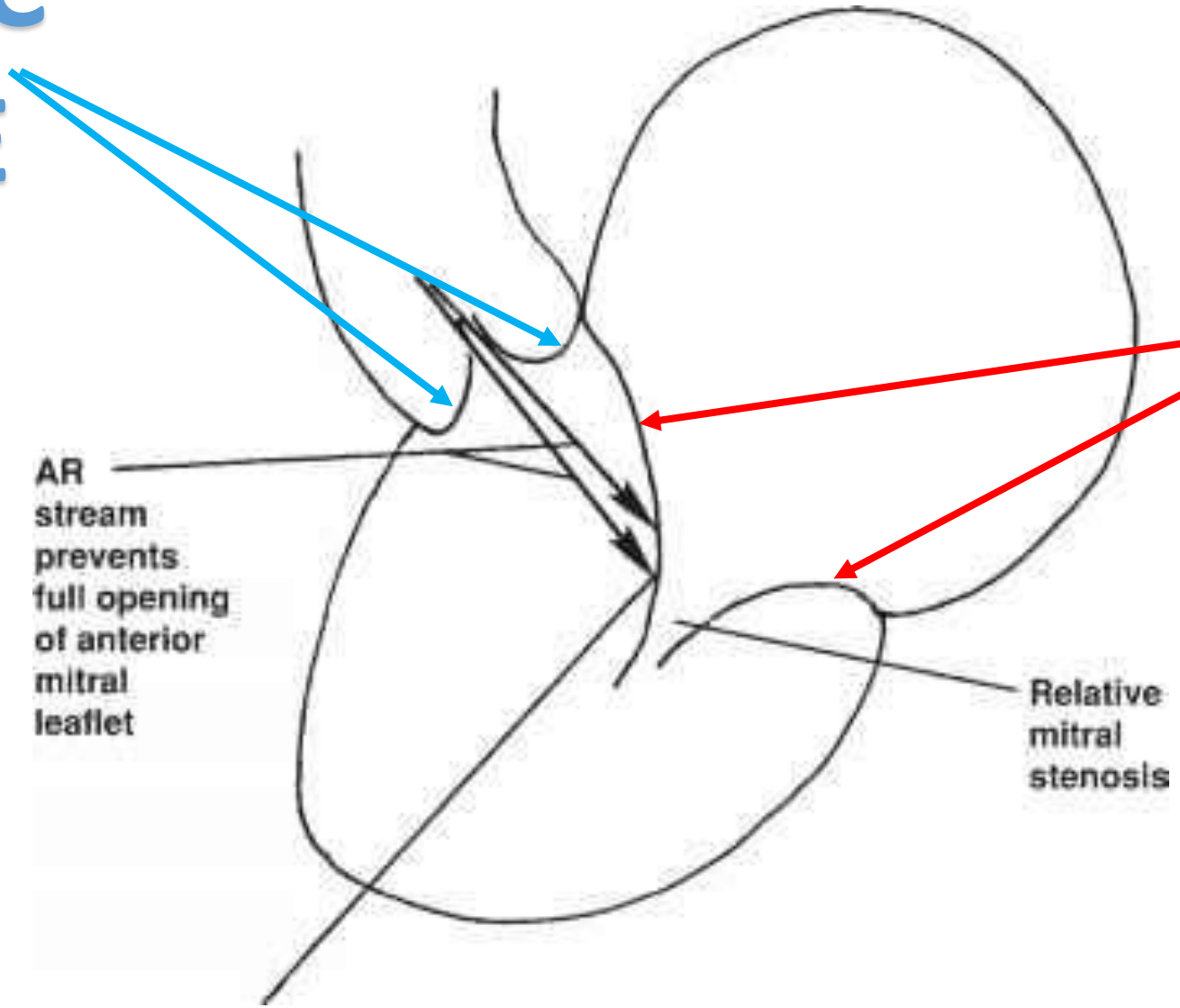
SYTOLIC MURMUR	TIMING	SITE	CHARACHTER	RADIATION	Effect of severity on intensity and duration	Effect of respiration
AS	Ejection systolic	Aortic area	harsh	To caroted	↑ then ↓ when LV dysfunction	↑ with expiration
PS	Ejection systolic	pulmonary area	harsh	To left shoulder	↑ then ↓ when RV dysfunction	↑ with inspiration
MR due to mitral valve prolapse	Mid systolic	Mitral area	blowing	To axilla	↑ The click earlier and closer to S1	
MR	Pan-systolic	Mitral area	blowing	To axilla	↑	↑ with expiration
TR	Pan-systolic	Tricuspid area	blowing		↑	↑ with inspiration

DIASTOLIC MURMUR	TIMING	SITE	CHARACHTER	RADIATION	Effect of severity on intensity and duration	Effect of respiration
PR	Early diastolic murmur	Pulmonary area	blowing		↑	↑ with inspiration
AR	Early diastolic murmur	Aortic area (secondary = aortic root disease) Erb's area (primary = valve disease) : best on leaning forward and holding expiration	blowing		↑	↑ with expiration
Austin flint	Mid diastolic rumbling (Severe AR)	Mitral area	rumbling		↑	↑ with inspiration
MS	Mid diastolic rumbling	Mitral area best on left lateral position	rumbling		↑	↑ with expiration
TS	Mid diastolic rumbling	Tricuspid area	rumbling		↑	↑ with inspiration


1st
2nd
3rd
Atrial
A
Normal
B
Aortic stenosis
C
Mitral regurgitation
D
Aortic regurgitation
E
Mitral stenosis
F
Ventricular
septal defect
Diastole
Systole
Diastole
Systole

AORTIC VALVE

MITRAL VALVE



Mechanism of Austin flint murmur

- **Chest** :
  - Crepitations : pulmonary oedema (LHF)
  - Pleural effusion : RHF

- **Abdomen** :
  - Ascites , tender hepatomegaly (hepatic congestion) : RHF
  - Tender pulsatile hepatomegaly : severe TR
  - Splenomegaly : chronic severe RHF : cardiac cirrhosis

Investigations :

- ***ECG :*** ***chambers enlargement , arrhythmias***
- ***Chest X ray :*** ***severely calcified valves***
  chambers, great vessels (aorta and pulmonary artery)
  Pulmonary congestion, pleural effusion
- ***Echocardiography :*** ***valves morphology and function***
  atrial size
  ventricular size , wall thickness and function
  pulmonary artery pressure
- ***Cardiac catheterization :*** ***Coexistent coronary artery diseases , severity of valvular disease***

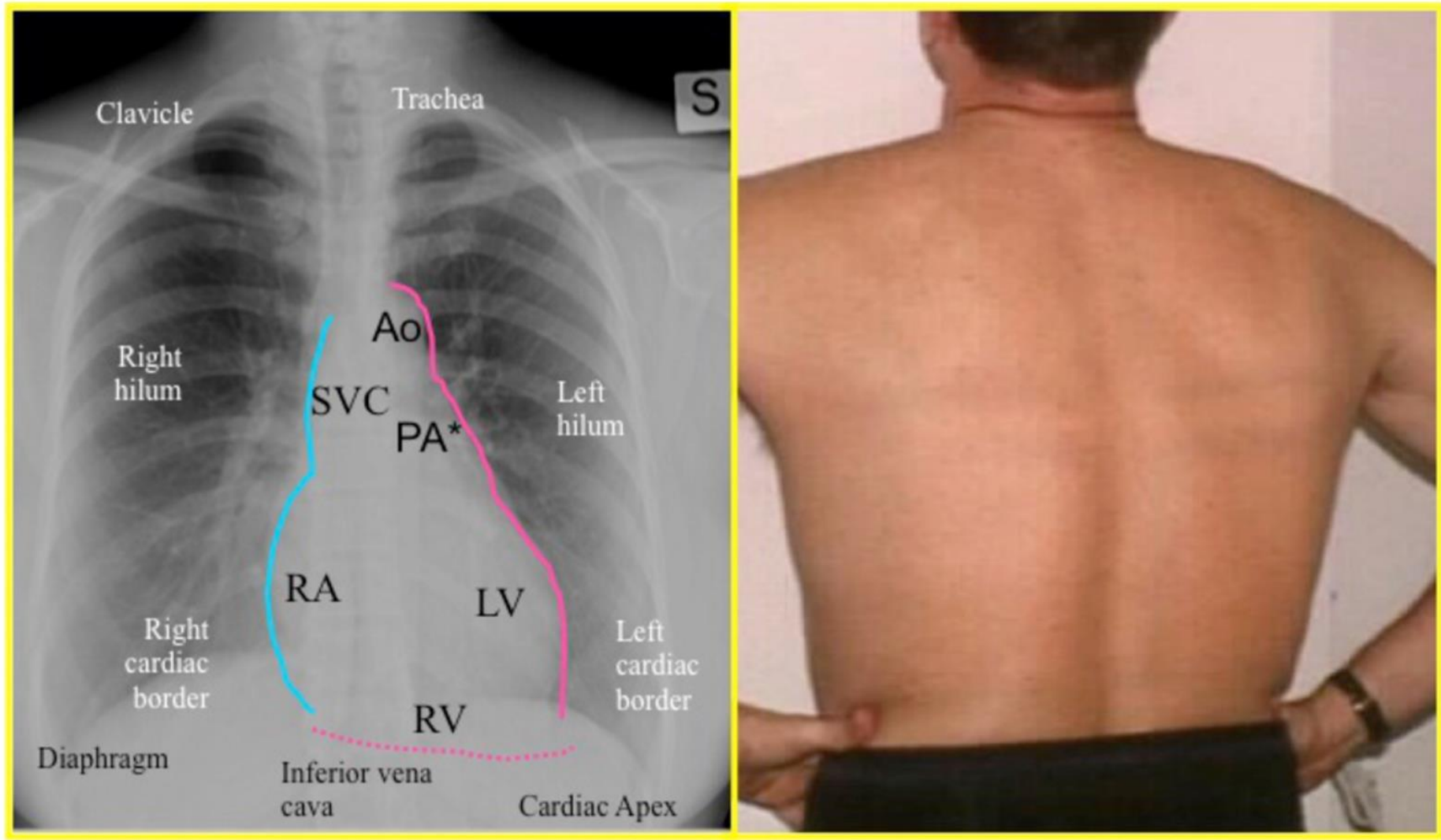


Fig. 1: Cardiac borders on a Posterior-Anterior (P-A) chest radiograph (CXR). Relationship between borders of the cardiac shadow and the adjiacent lung portion. Ao=aorta arch; SVC=superior vena cava; PA= pulmonary artery; RA=right atrium; LV=left ventricle; RV=right ventricle.

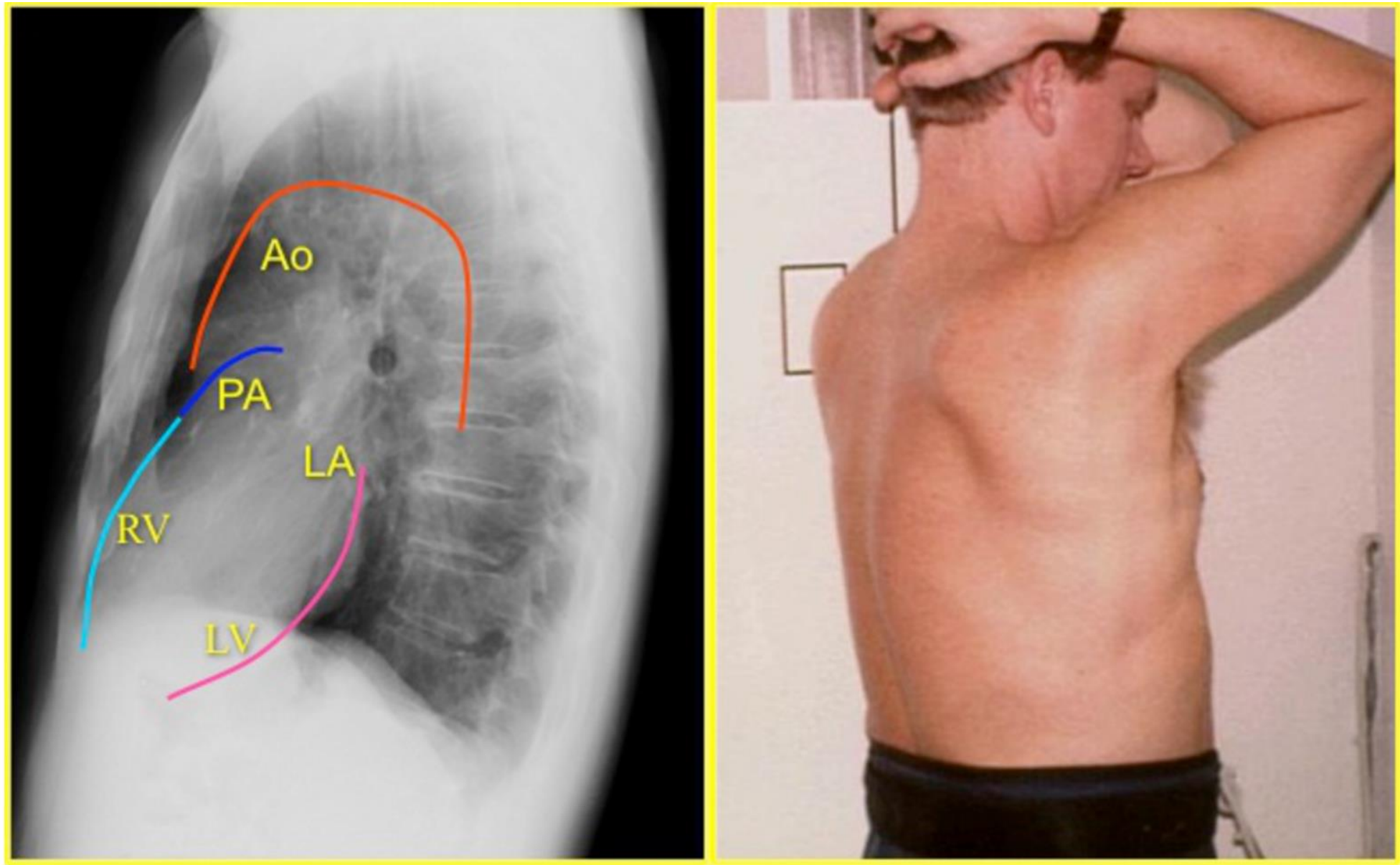
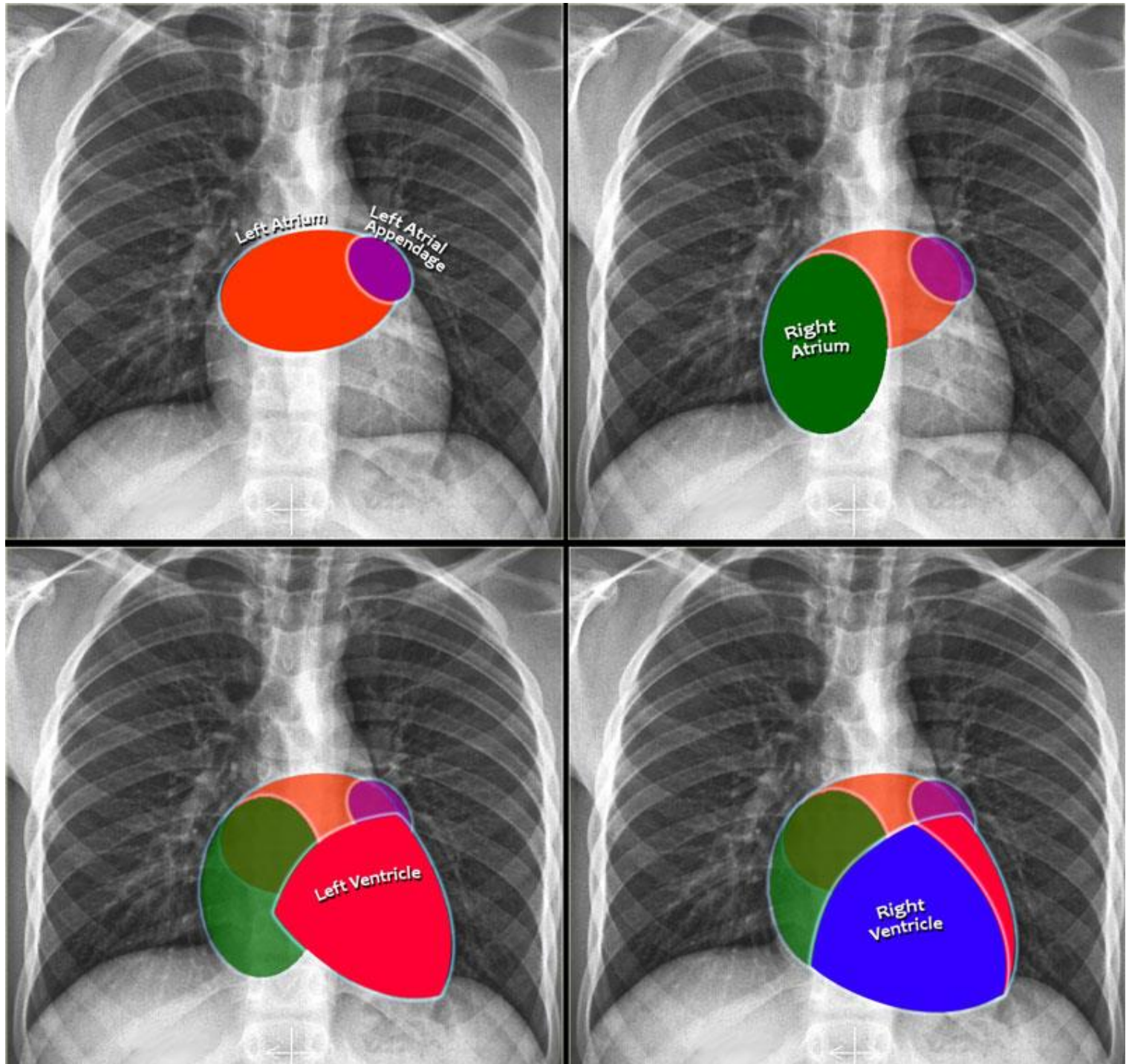
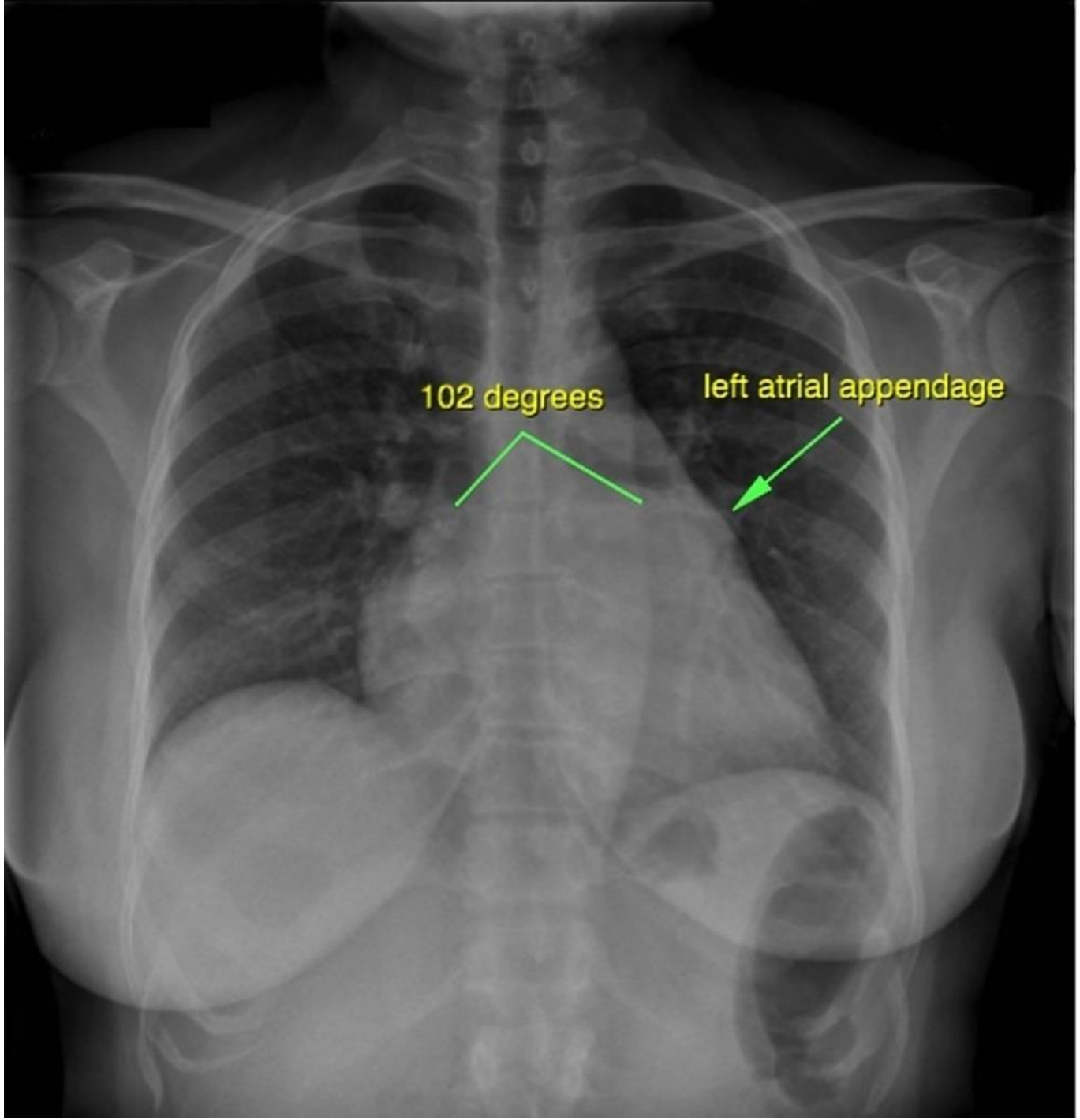
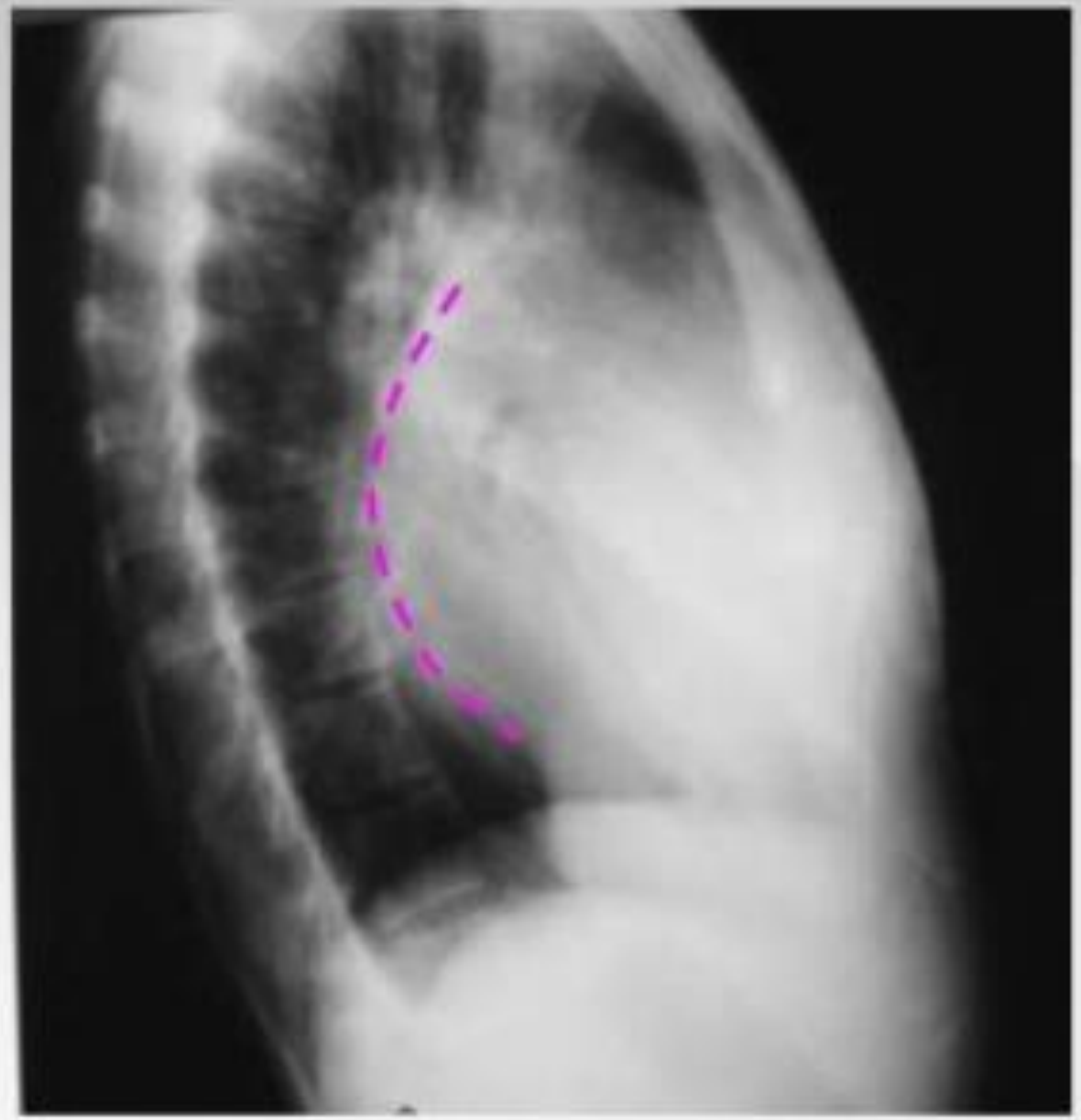


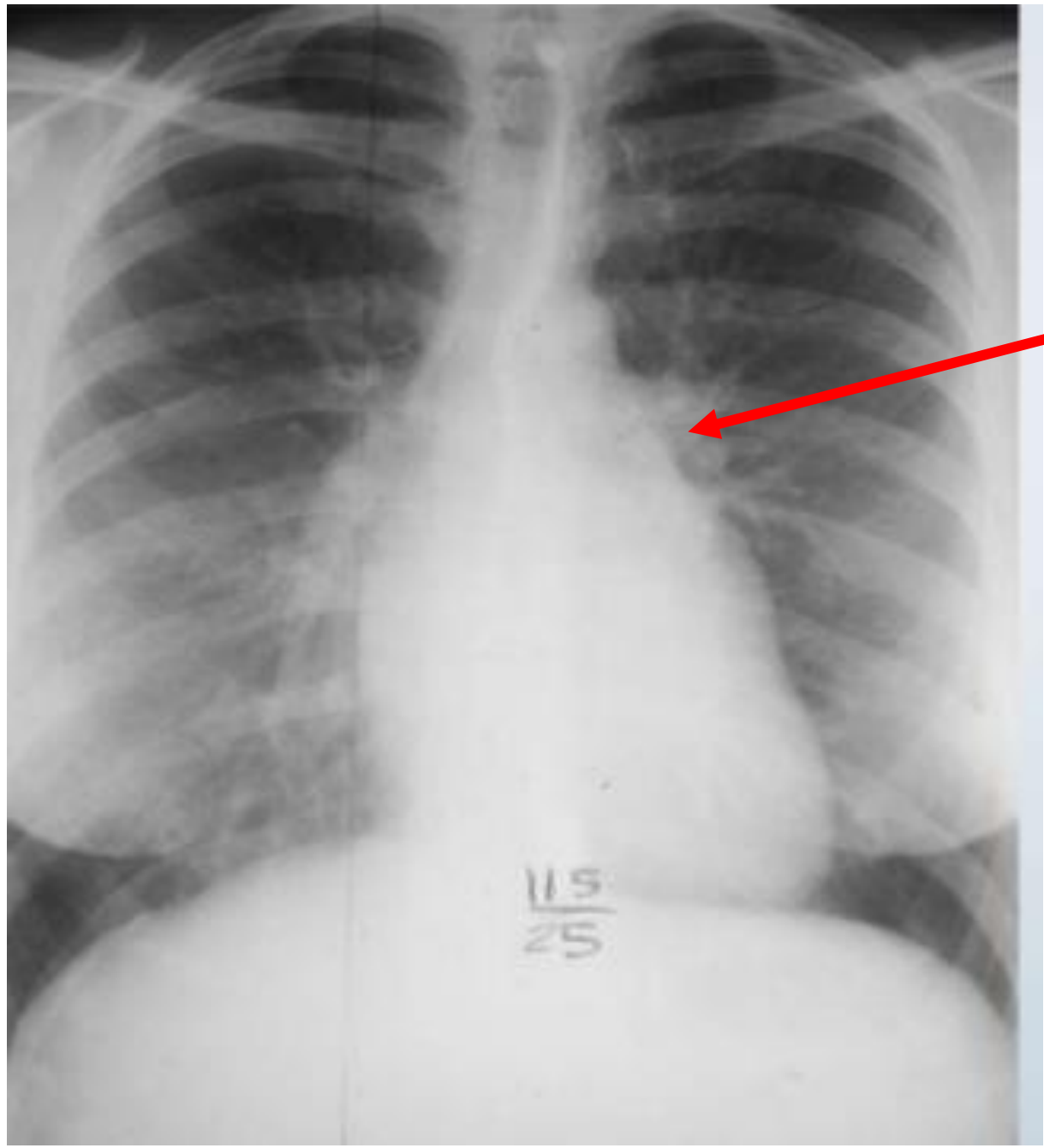
Fig. 7: Cardiac borders on a lateral CXR. Ao=Aorta; PA=pulmonary artery; RV=right ventricle; LV=left ventricle; LA=left atrium.


Left Atrium
Left Atrial Appendage
Right Atrium
Left Ventricle
Right Ventricle


102 degrees
left atrial appendage



- ***Lateral view:***
- Prominent posterosuperior cardiac border
- Posterior displacement and upliftment of left mainstem bronchus


LS
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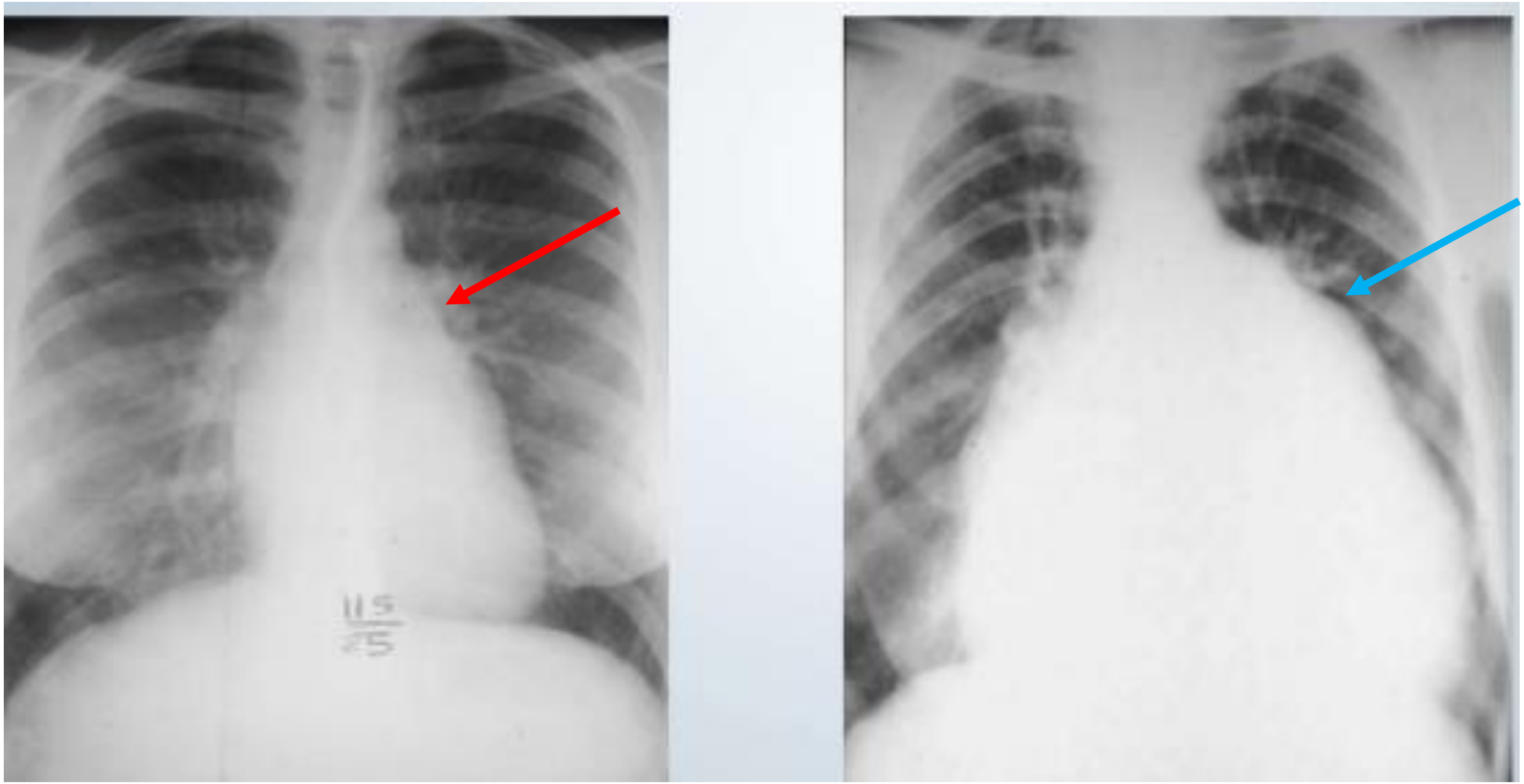
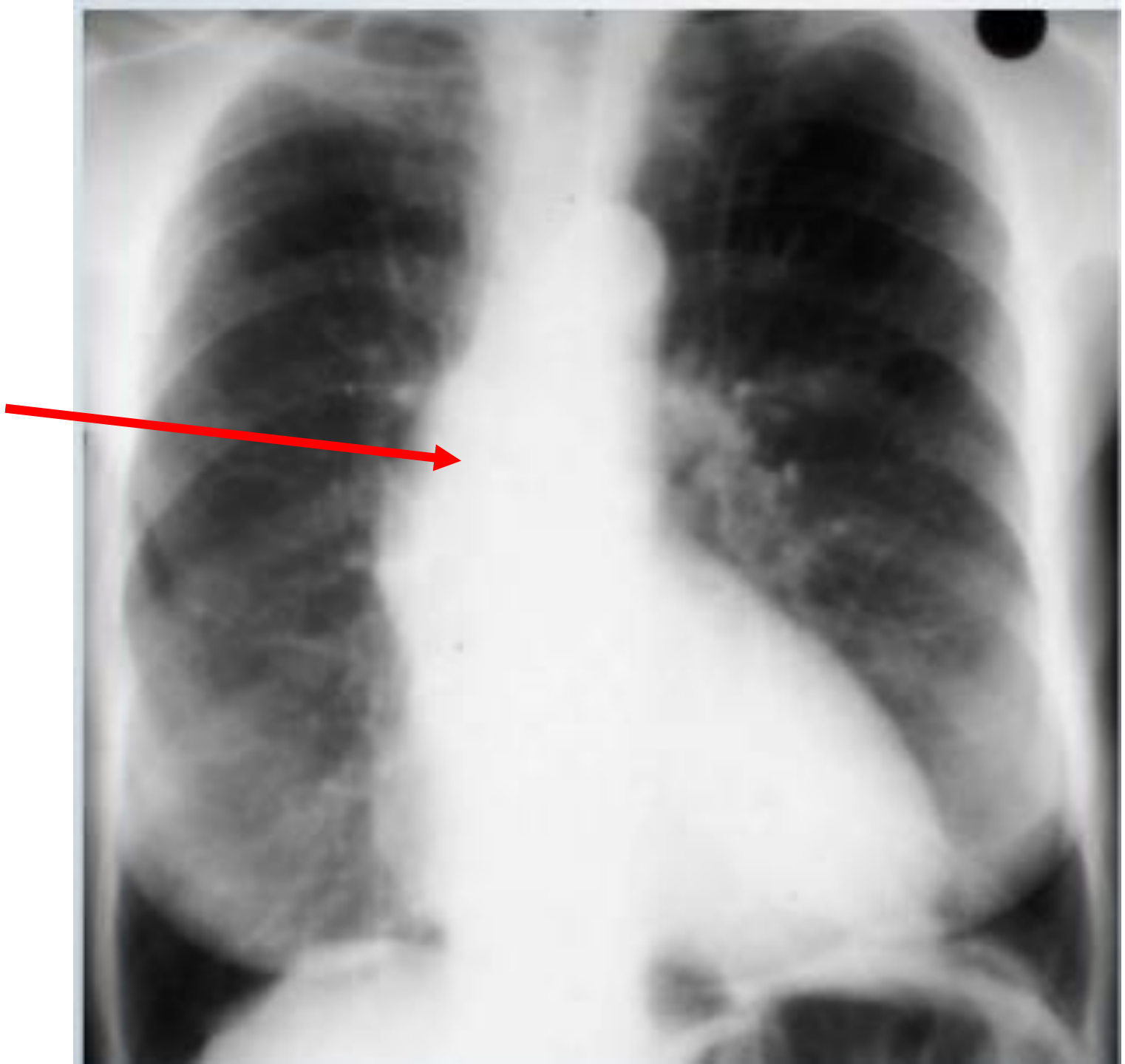
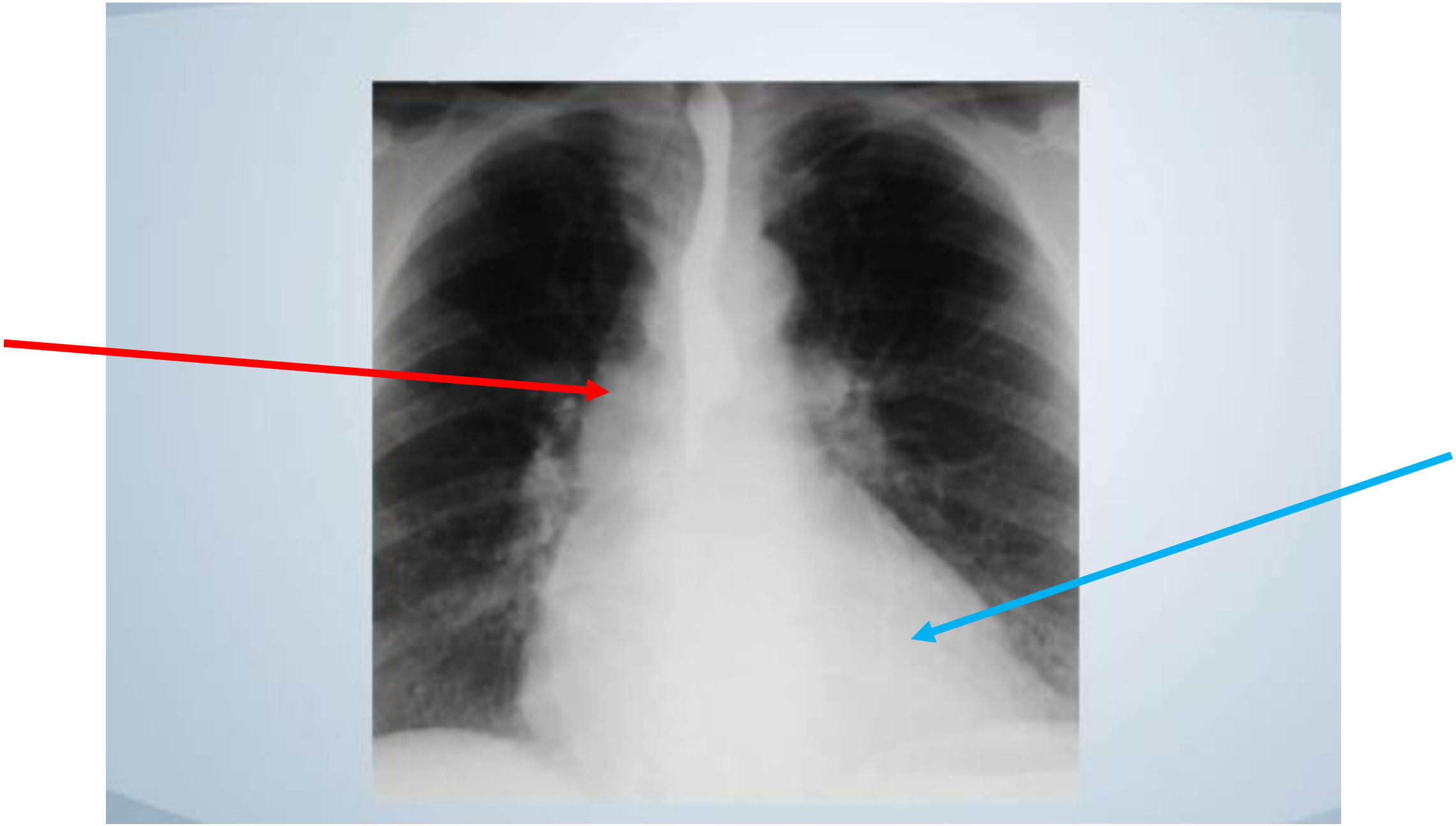
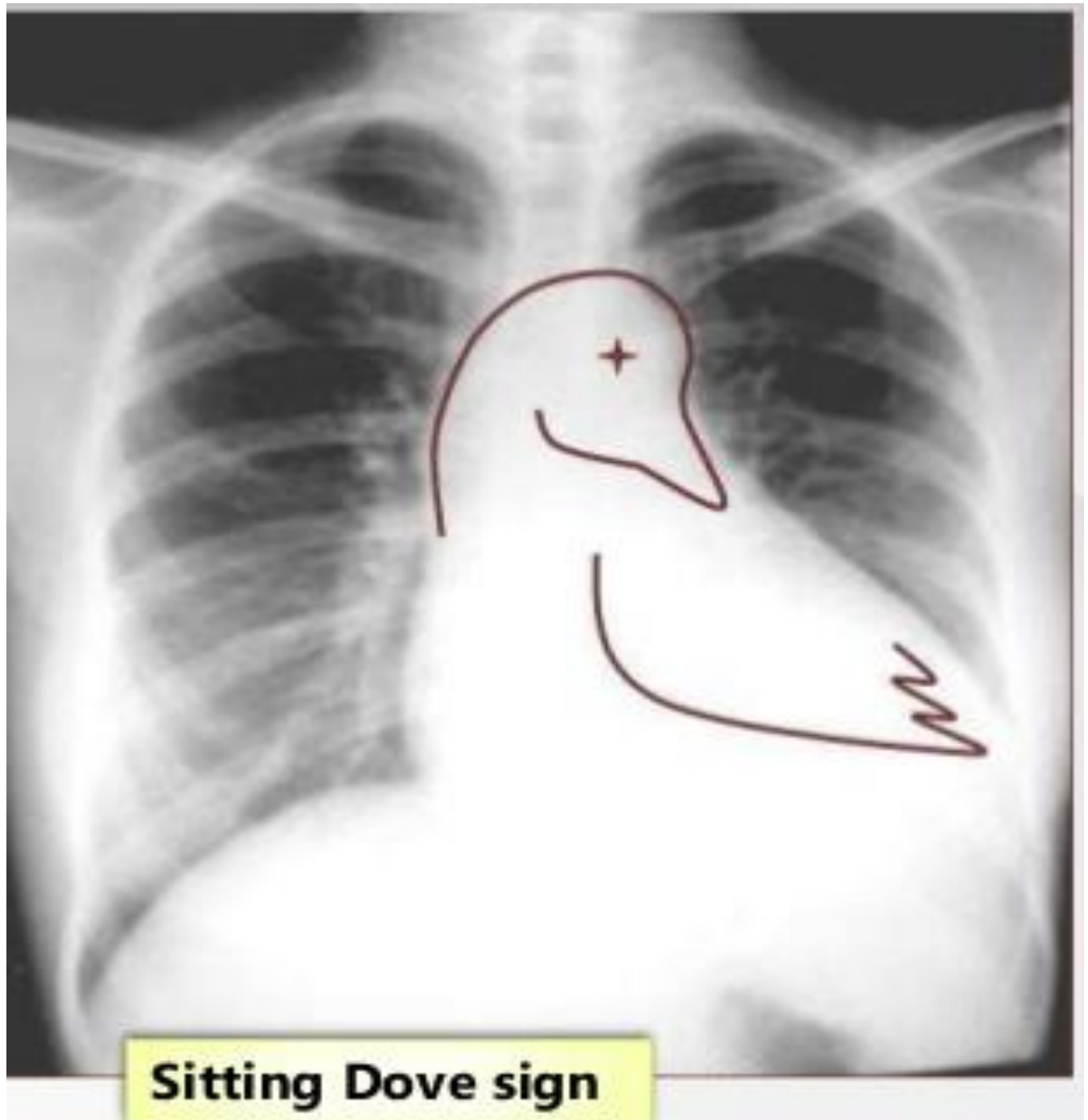
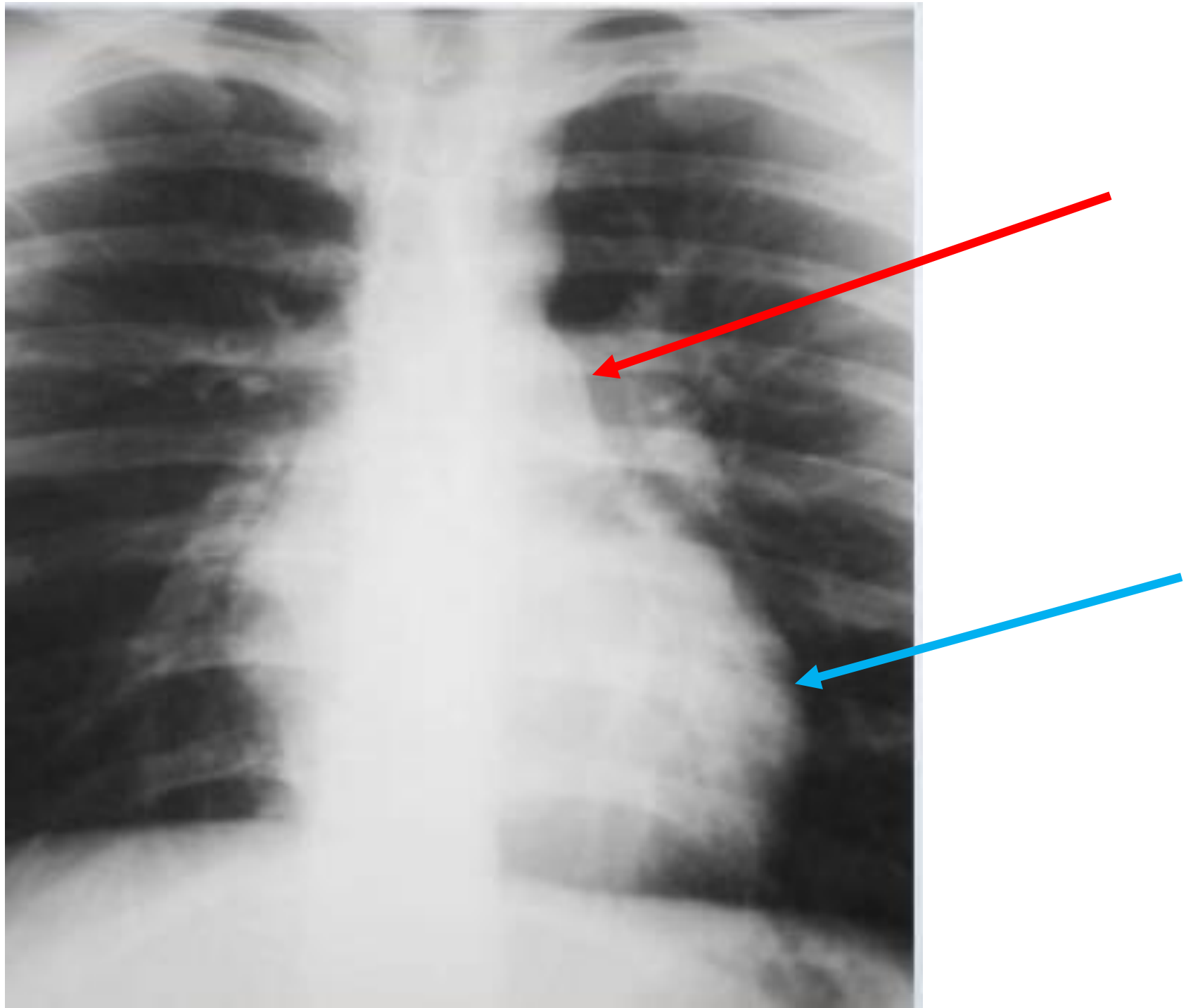
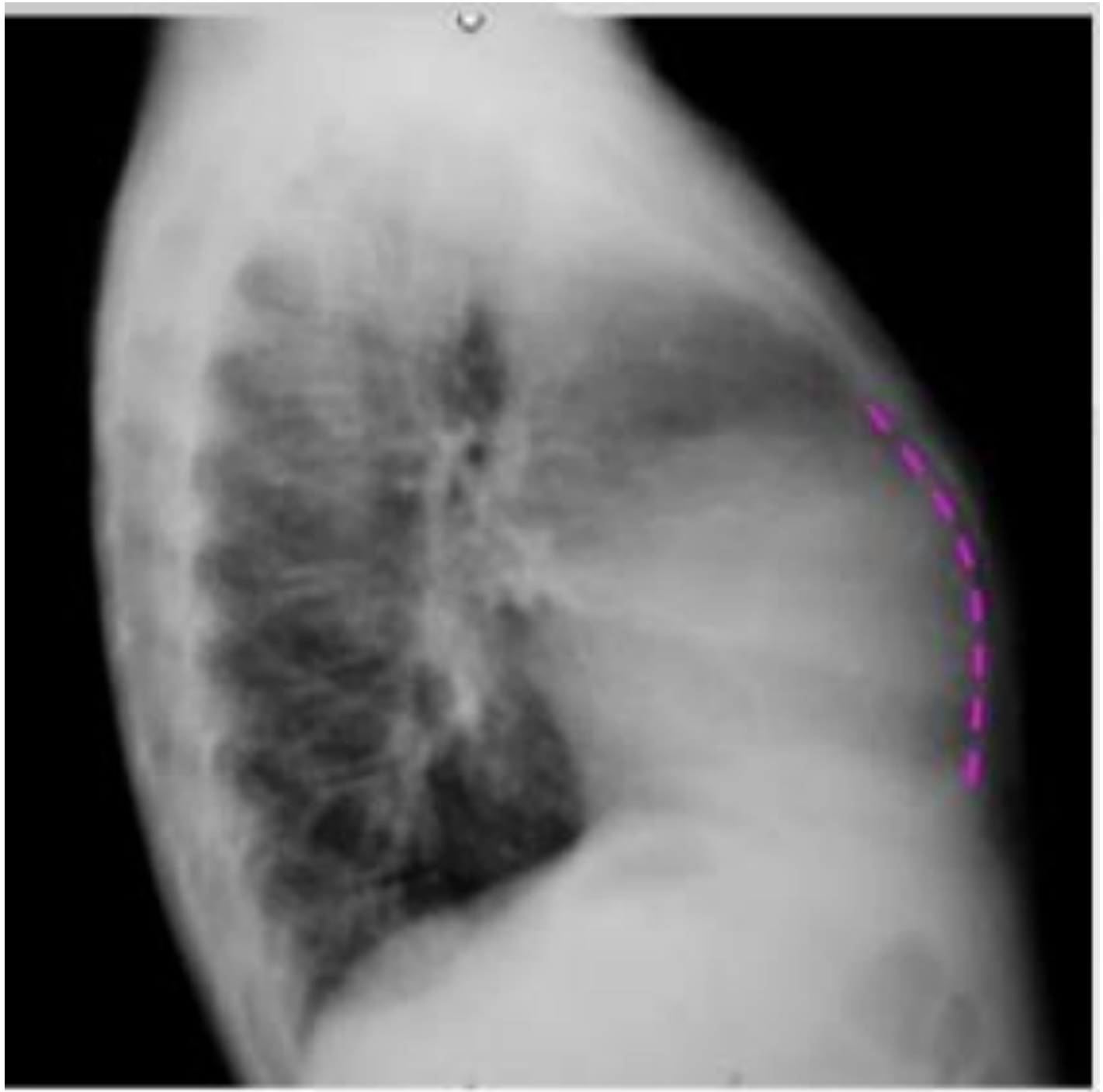







Sitting Dove sign





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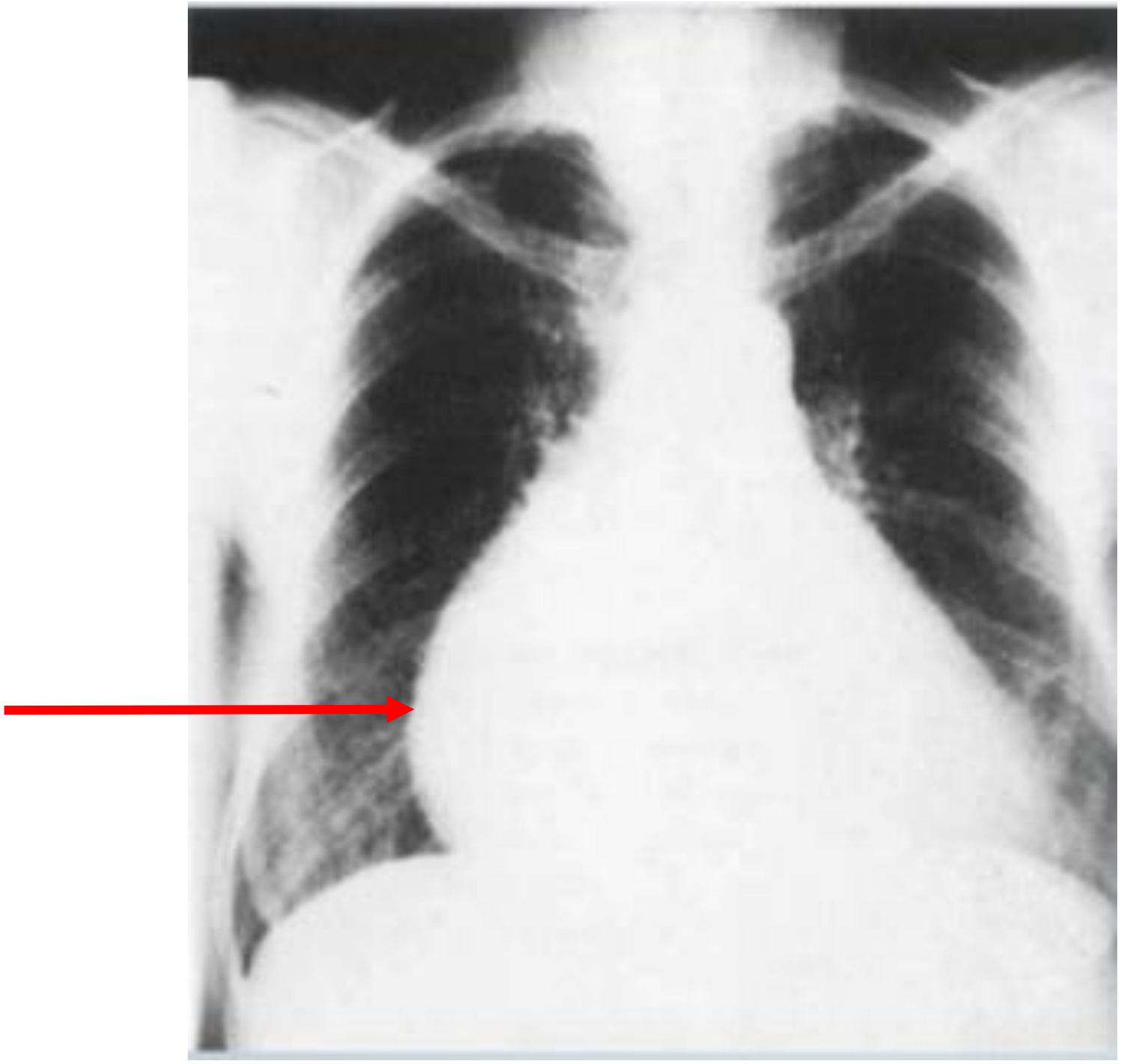
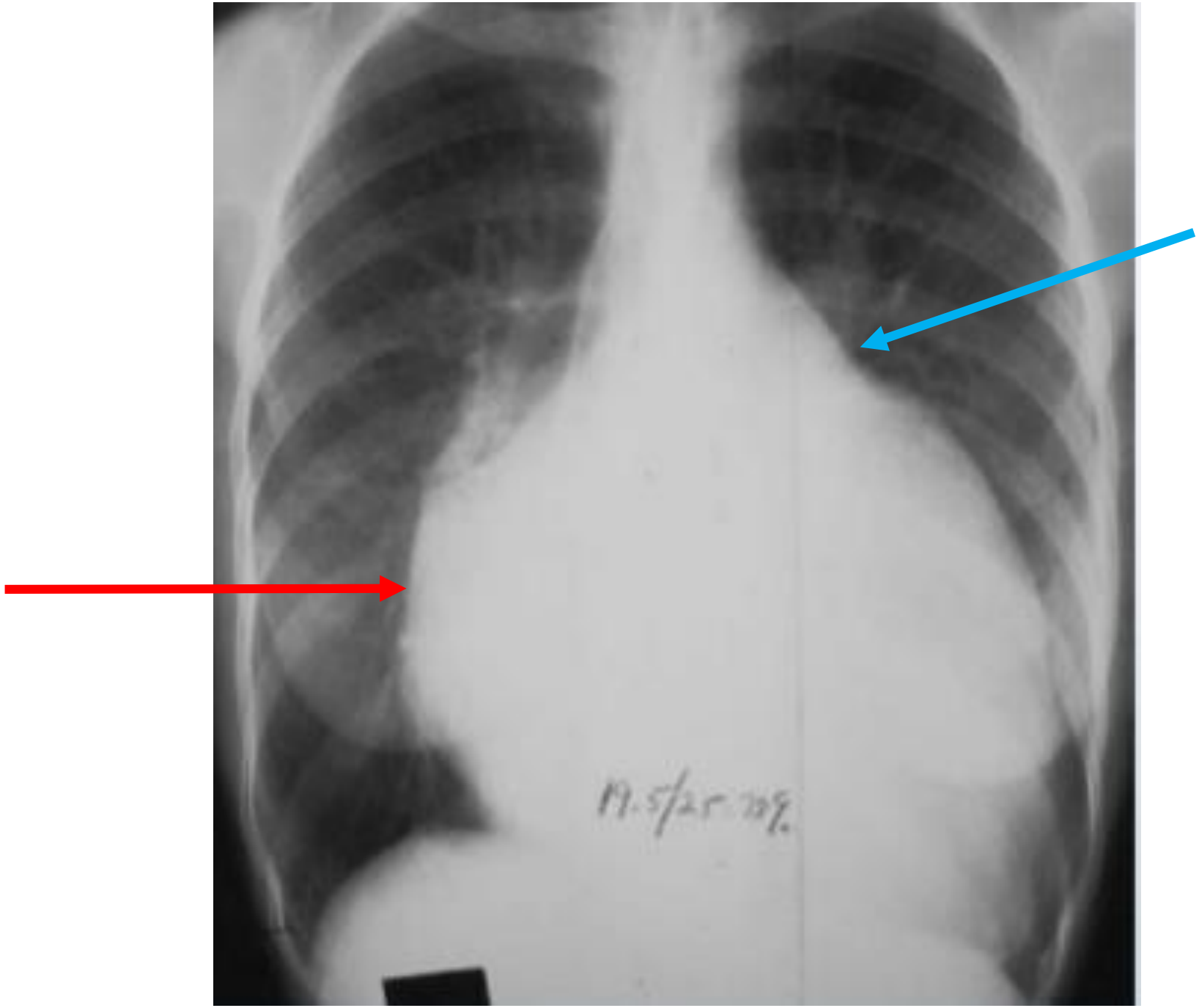
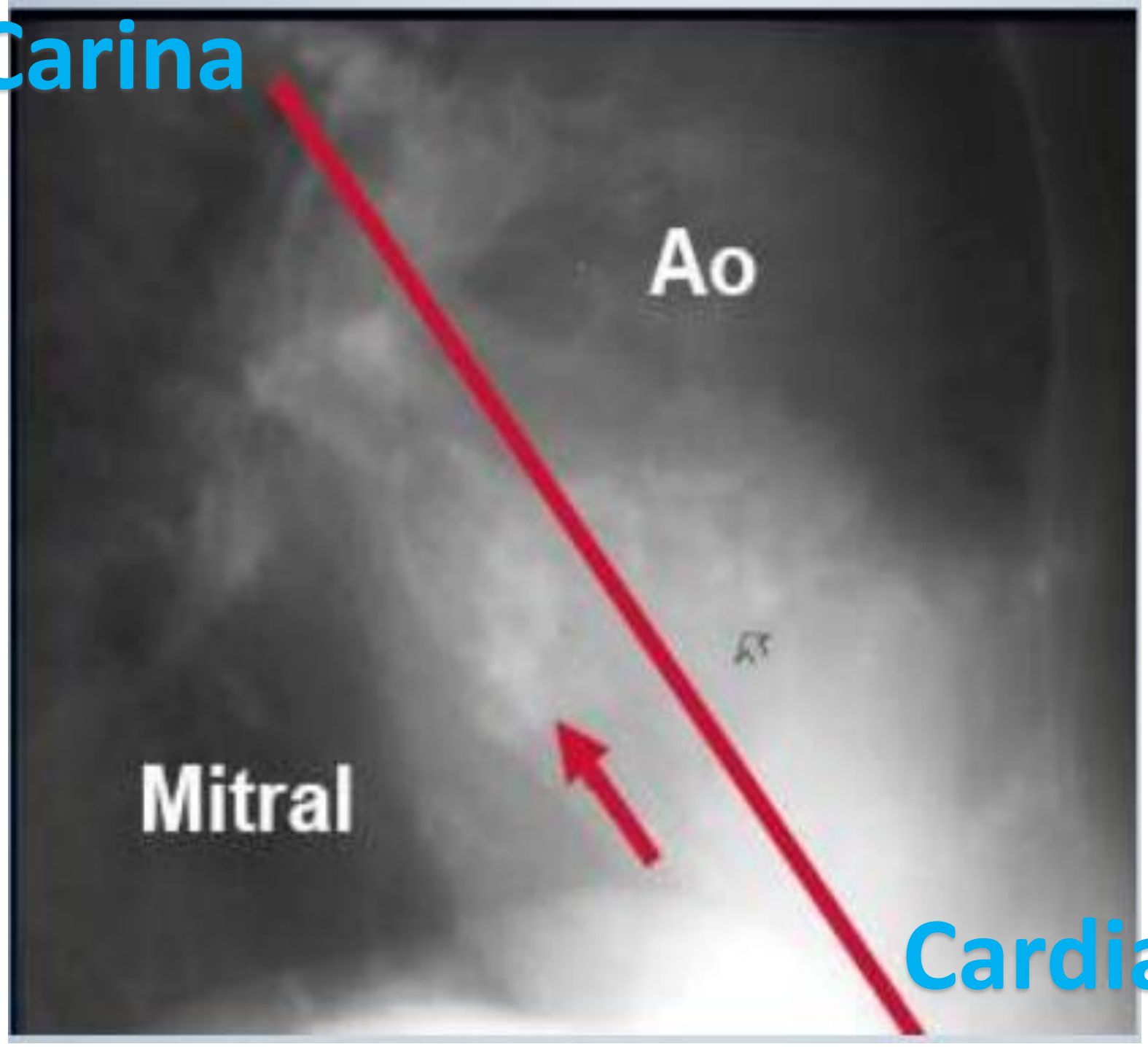
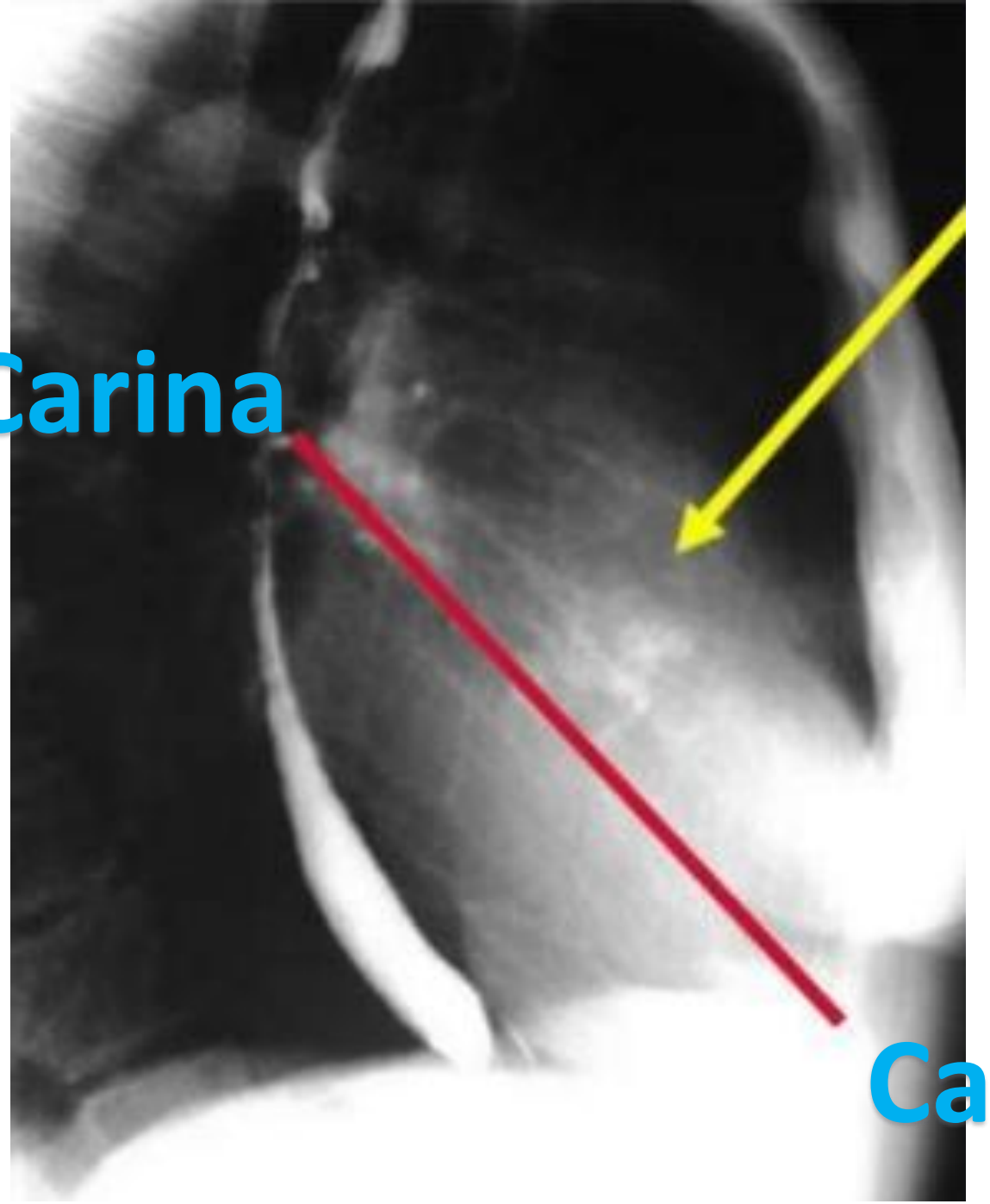


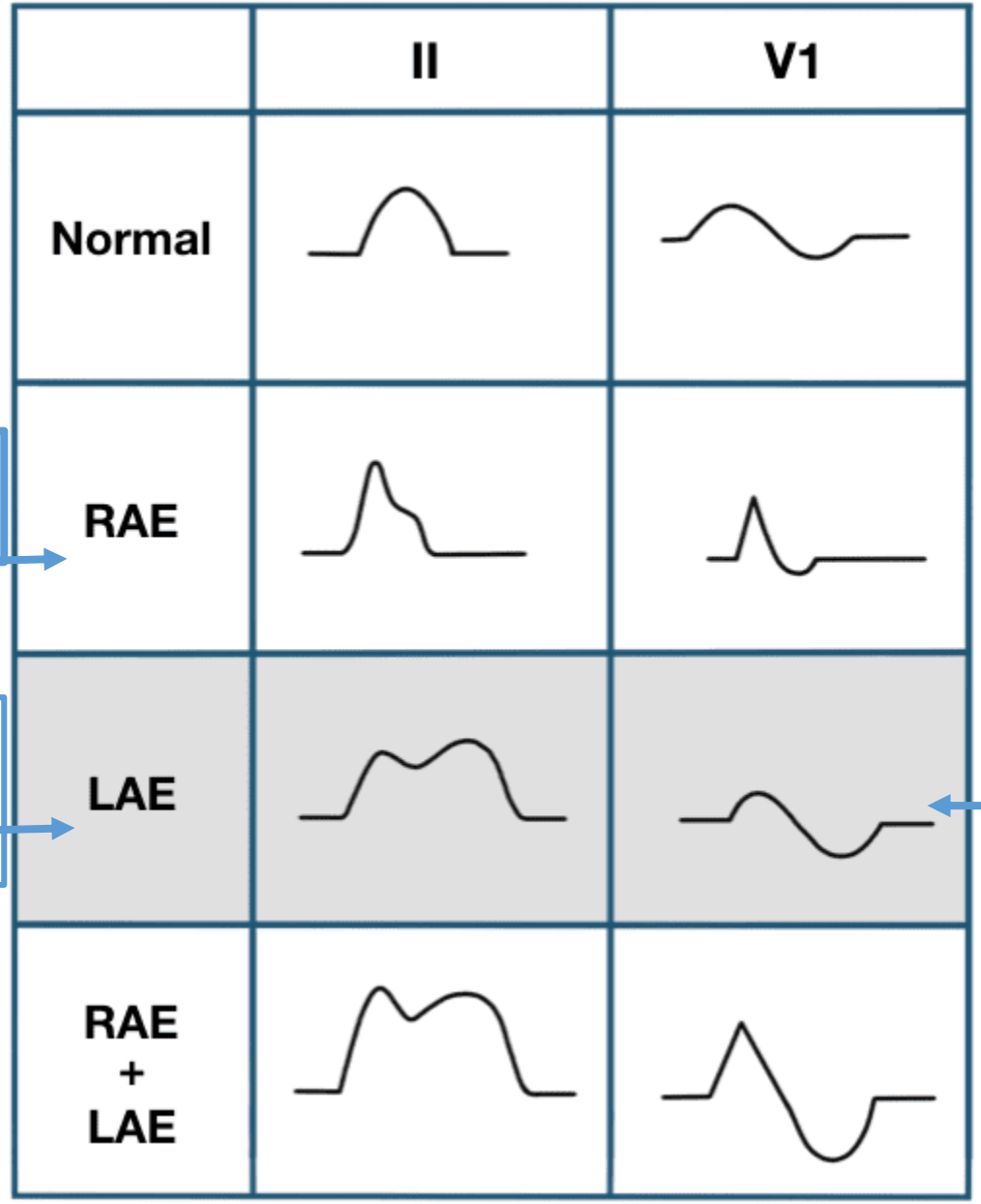



Carina
Ao
Mitral
Cardiac apex


Carina
Cardiac apex

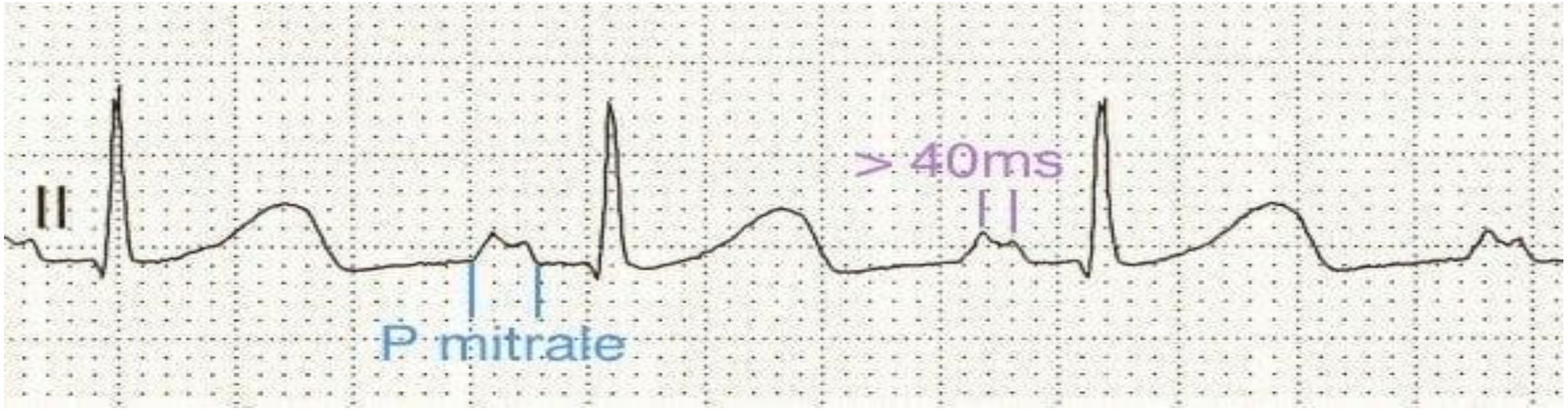
P pulmonale :
P wave amplitude > 2.5mm

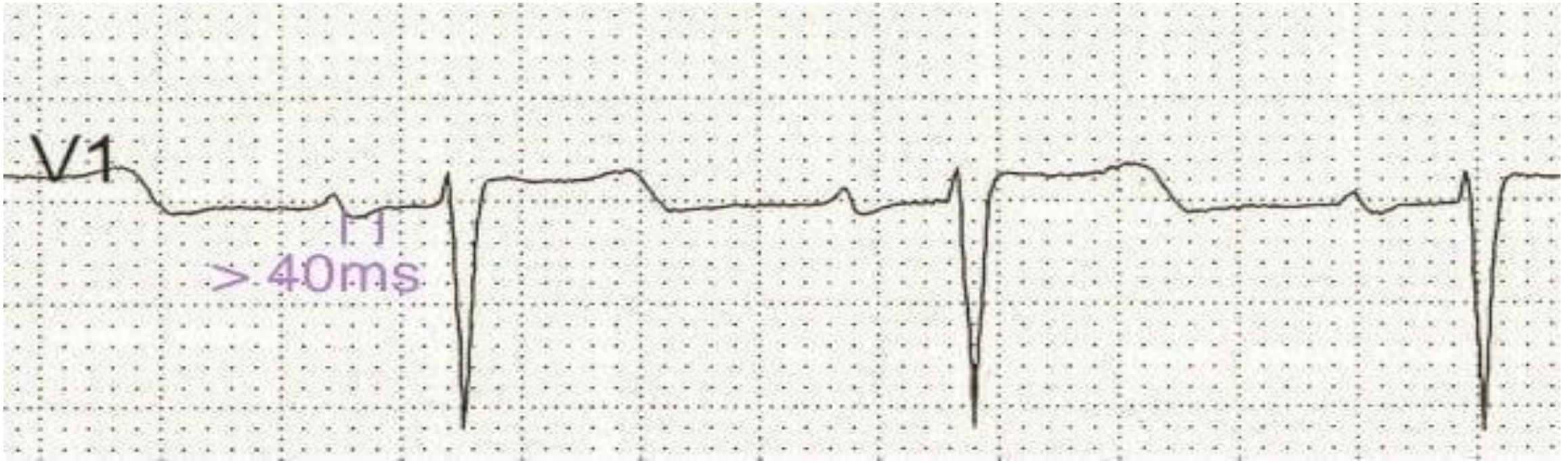
Bifid P wave with
> 40 ms between the two peaks
Total duration > 110 ms

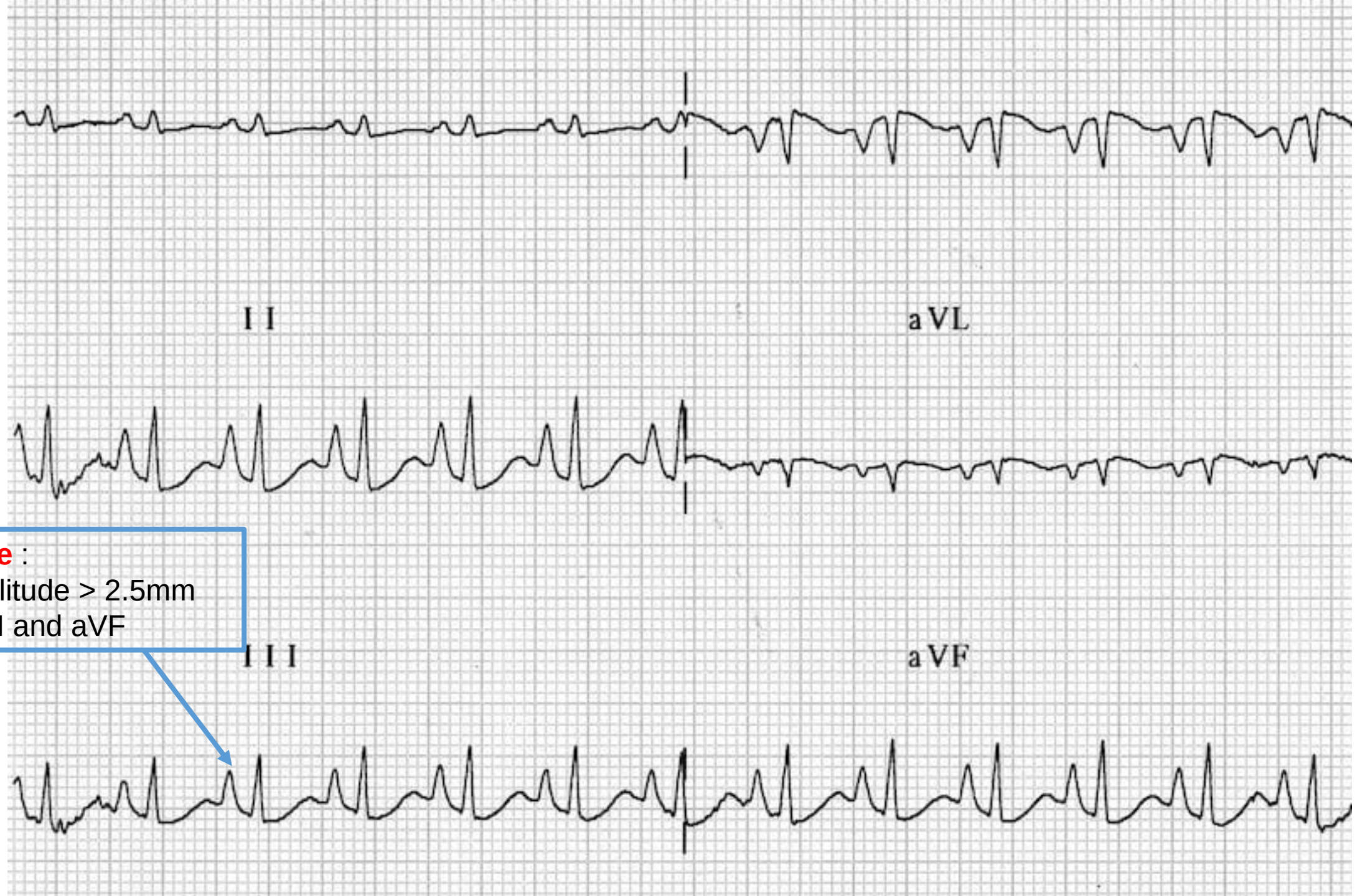


Biphasic P wave with terminal negative portion:

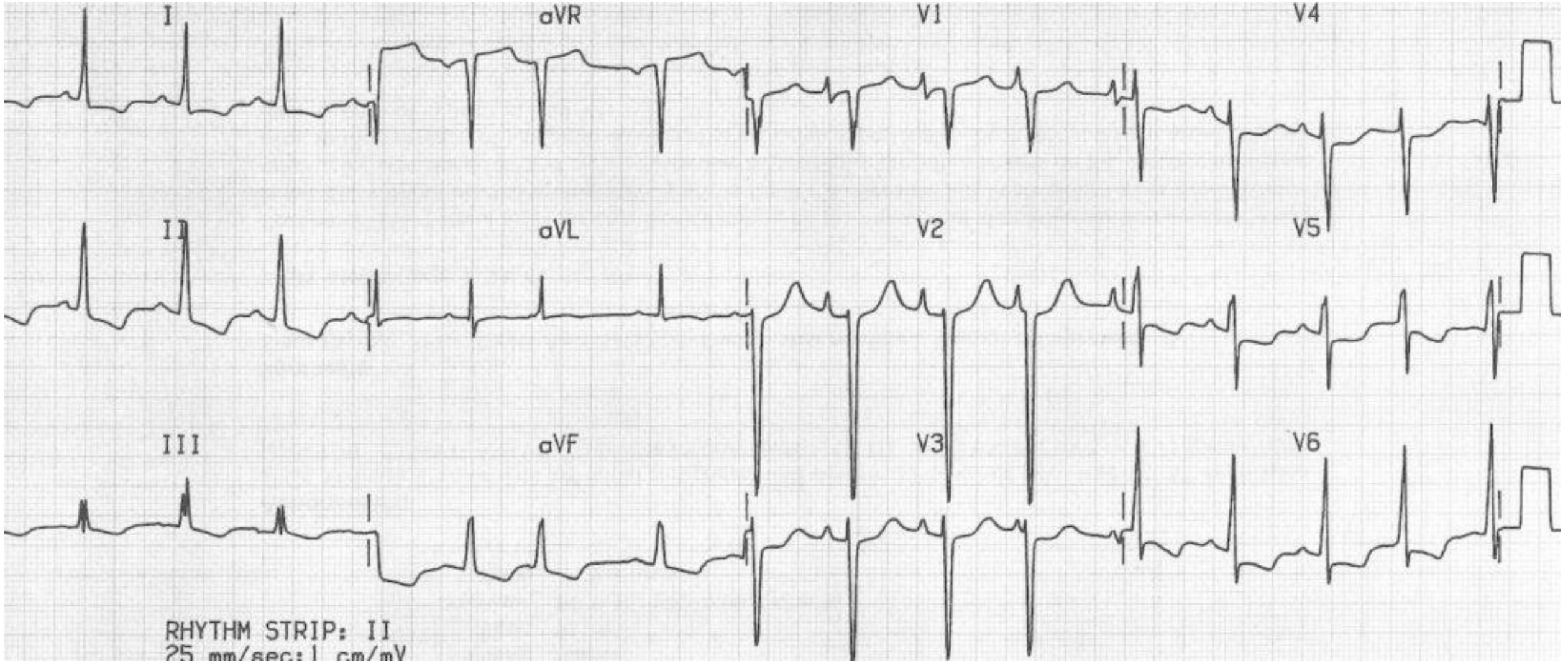
> 40 ms duration + > 1mm deep


II
> 40ms
P mitrale


V1
> 40ms



P pulmonale :
P wave amplitude > 2.5mm
in leads II, III and aVF


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
RHYTHM STRIP: II
25 mm/sec; 1 cm/mV

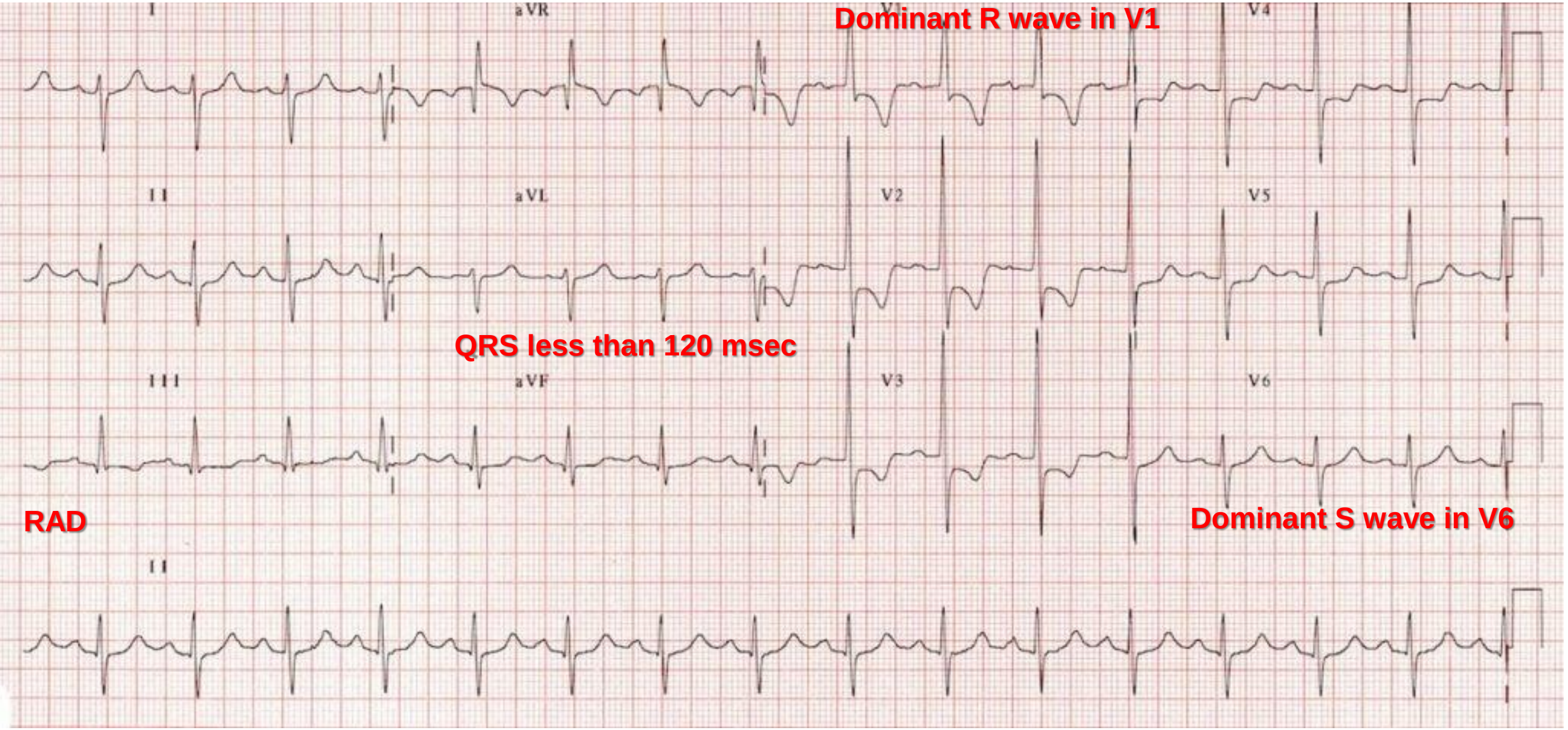
RV ENLARGEMENT

Diagnostic criteria

- RAD
- Dominant R wave in V1 (> 7mm tall or R/S ratio > 1).
- Dominant S wave in V5 or V6 (> 7mm deep or R/S ratio < 1).
- *QRS duration < 120ms (i.e. changes not due to RBBB).*

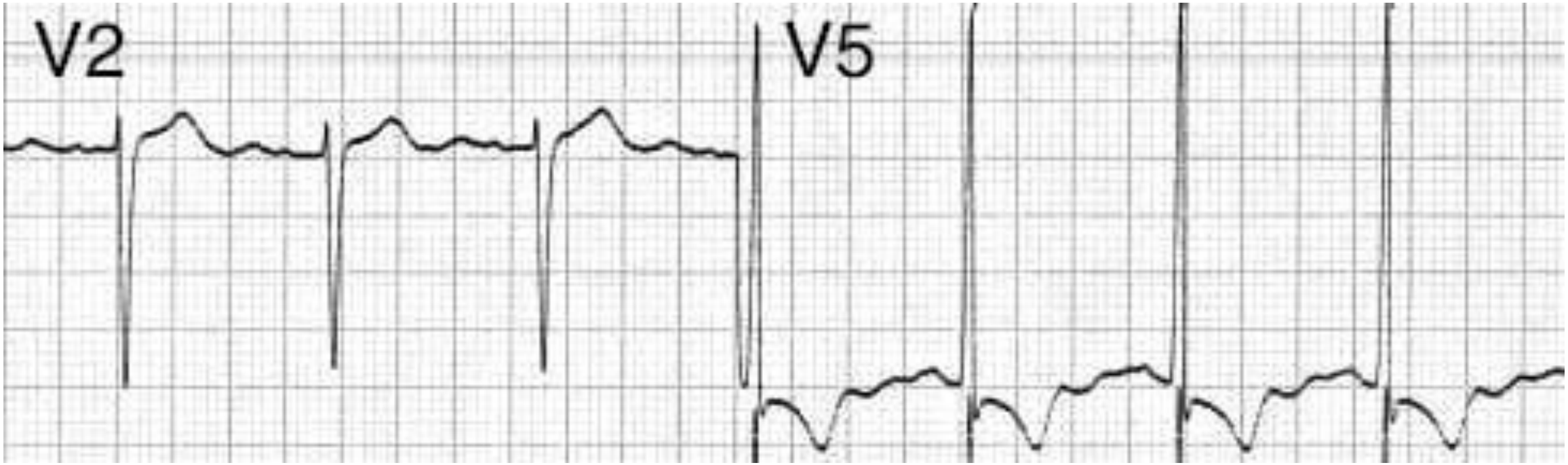
Supporting criteria

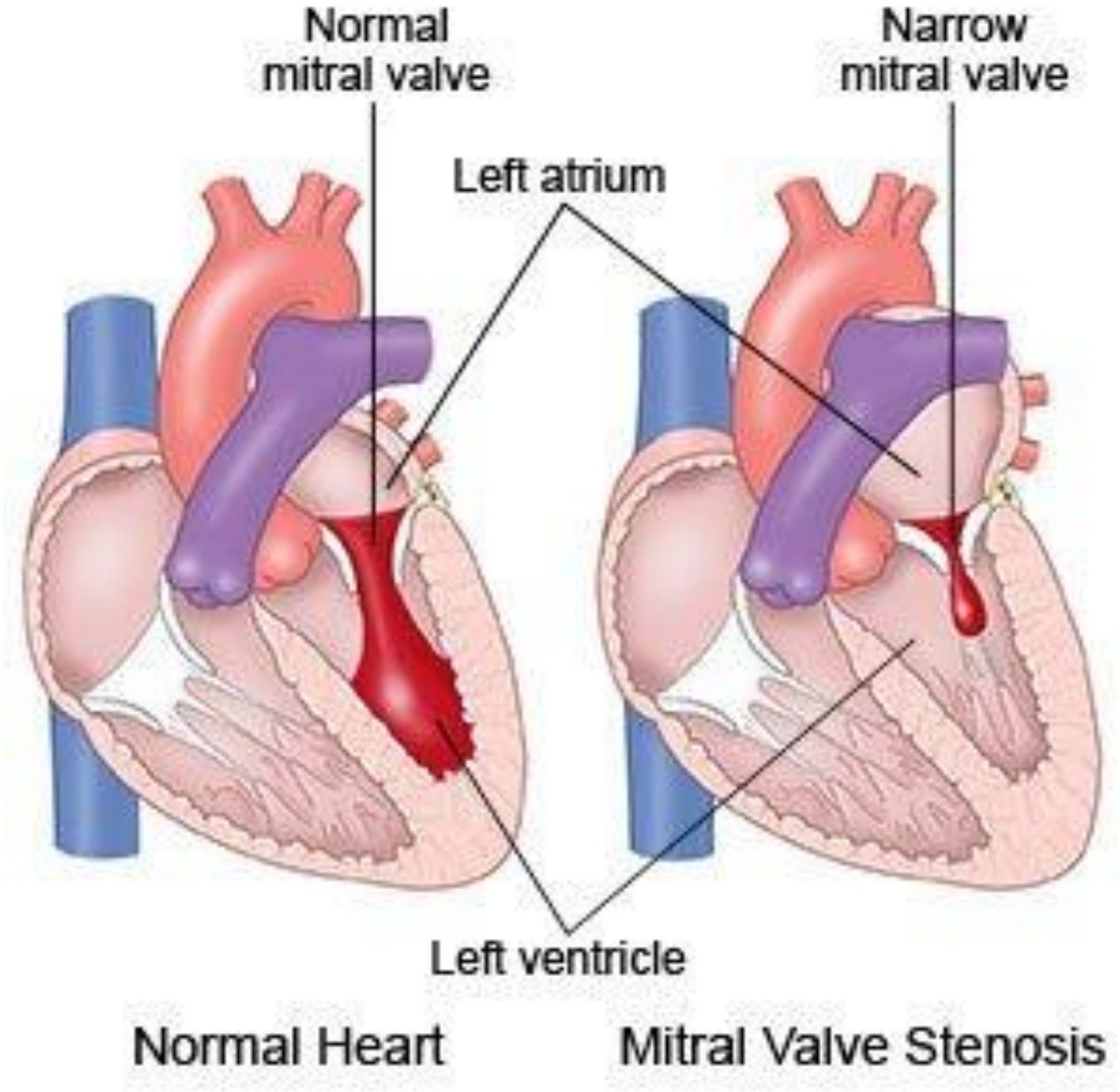
RA enlargement (P pulmonale).
RV strain pattern = ST depression / T wave inversion in the right precordial (V1-4) and inferior (II, III, aVF) leads.
S1 S2 S3 pattern = far right axis deviation with dominant S waves in leads I, II and III.
Deep S waves in the lateral leads (I, aVL, V5-V6).


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
Dominant R wave in V1
QRS less than 120 msec
RAD
Dominant S wave in V6

LV ENLARGMENT

- R wave in V5 or V6 plus S wave in V1 > 35 mm
- Largest R wave plus largest S wave in precordial leads > 45 mm

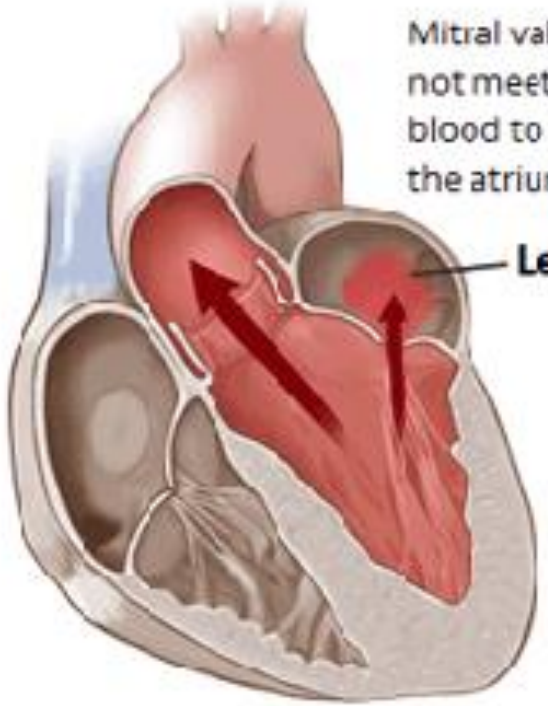


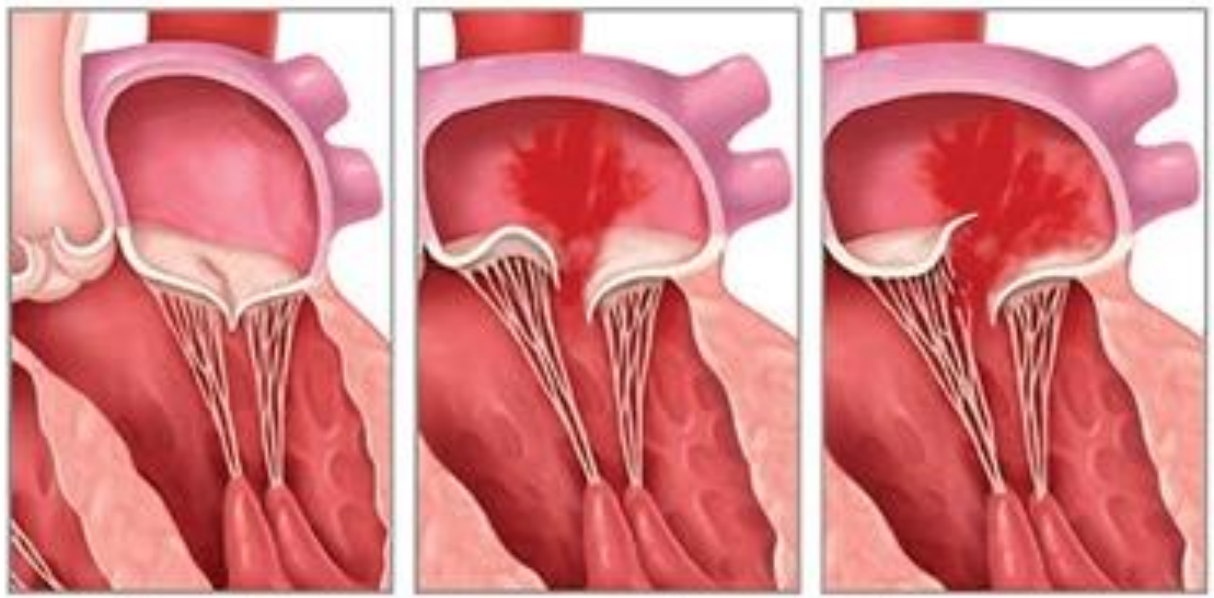

Normal
mitral valve
Narrow
mitral valve
Left atrium
Left ventricle
Normal Heart
Mitral Valve Stenosis

Causes of mitral stenosis

Mitral stenosis is almost always rheumatic in origin
There is also a rare form of congenital mitral stenosis.

Mitral Regurgitation



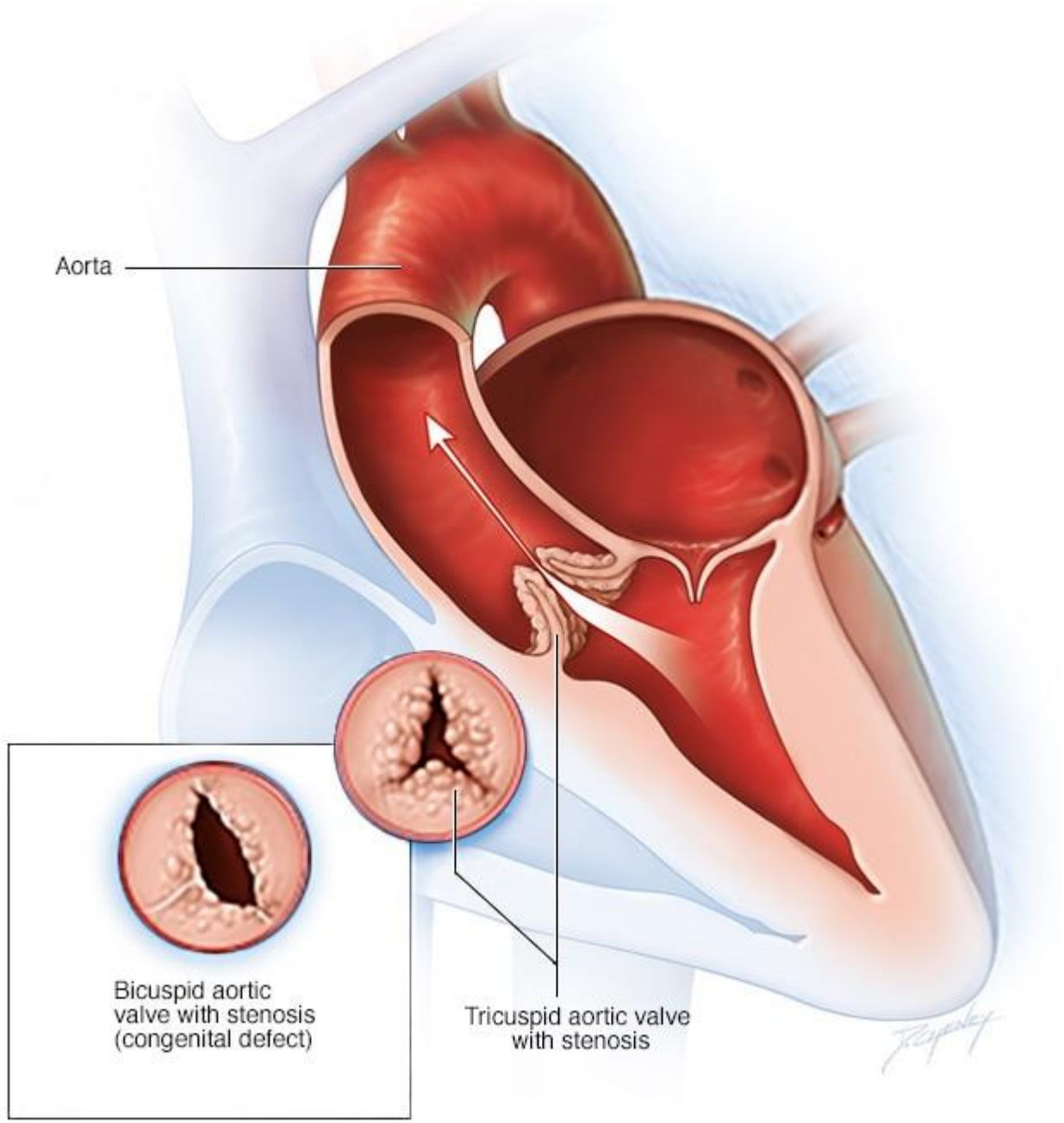


Normal

Regurgitation

16.80 Causes of mitral regurgitation

- Mitral valve prolapse
- Dilatation of the left ventricle and mitral valve ring (e.g. coronary artery disease, cardiomyopathy)
- Damage to valve cusps and chordae (e.g. rheumatic heart disease, endocarditis)
- Ischaemia or infarction of the papillary muscle



16.84 Causes of aortic stenosis

Infants, children, adolescents

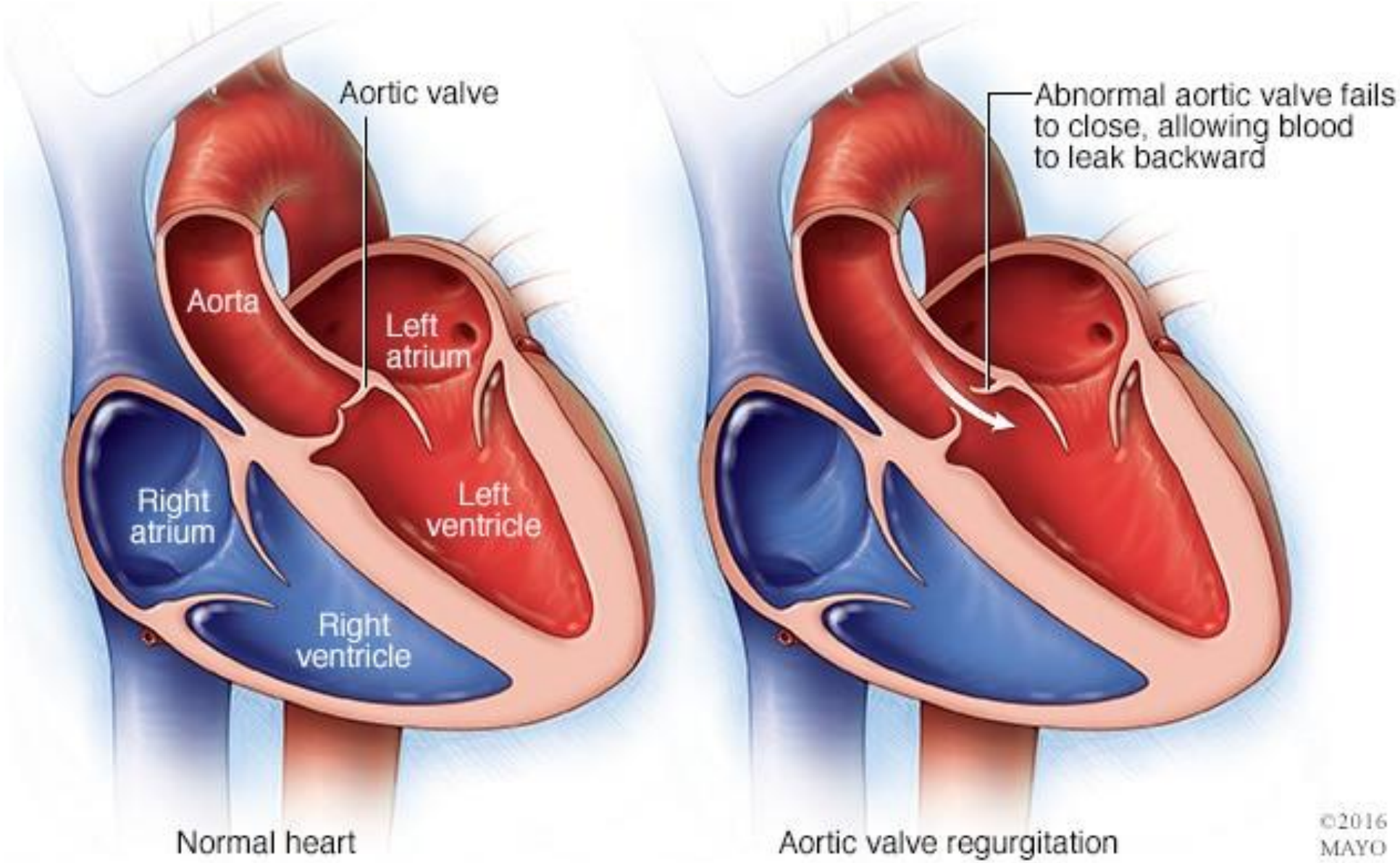
- Congenital aortic stenosis
- Congenital subvalvular aortic stenosis
- Congenital supravalvular aortic stenosis

Young adults to middle-aged

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

Middle-aged to elderly

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



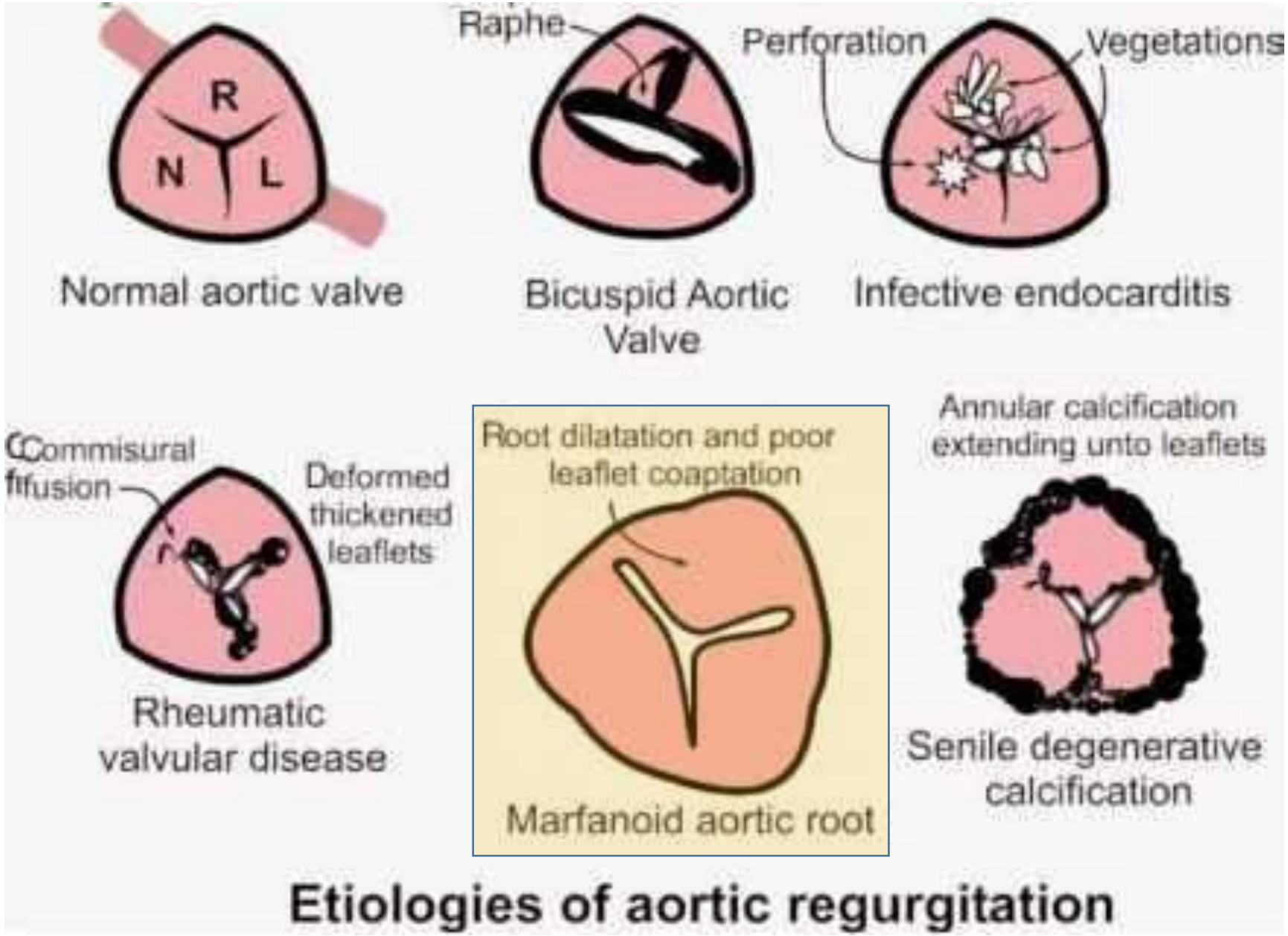
16.88 Causes of aortic regurgitation

Congenital

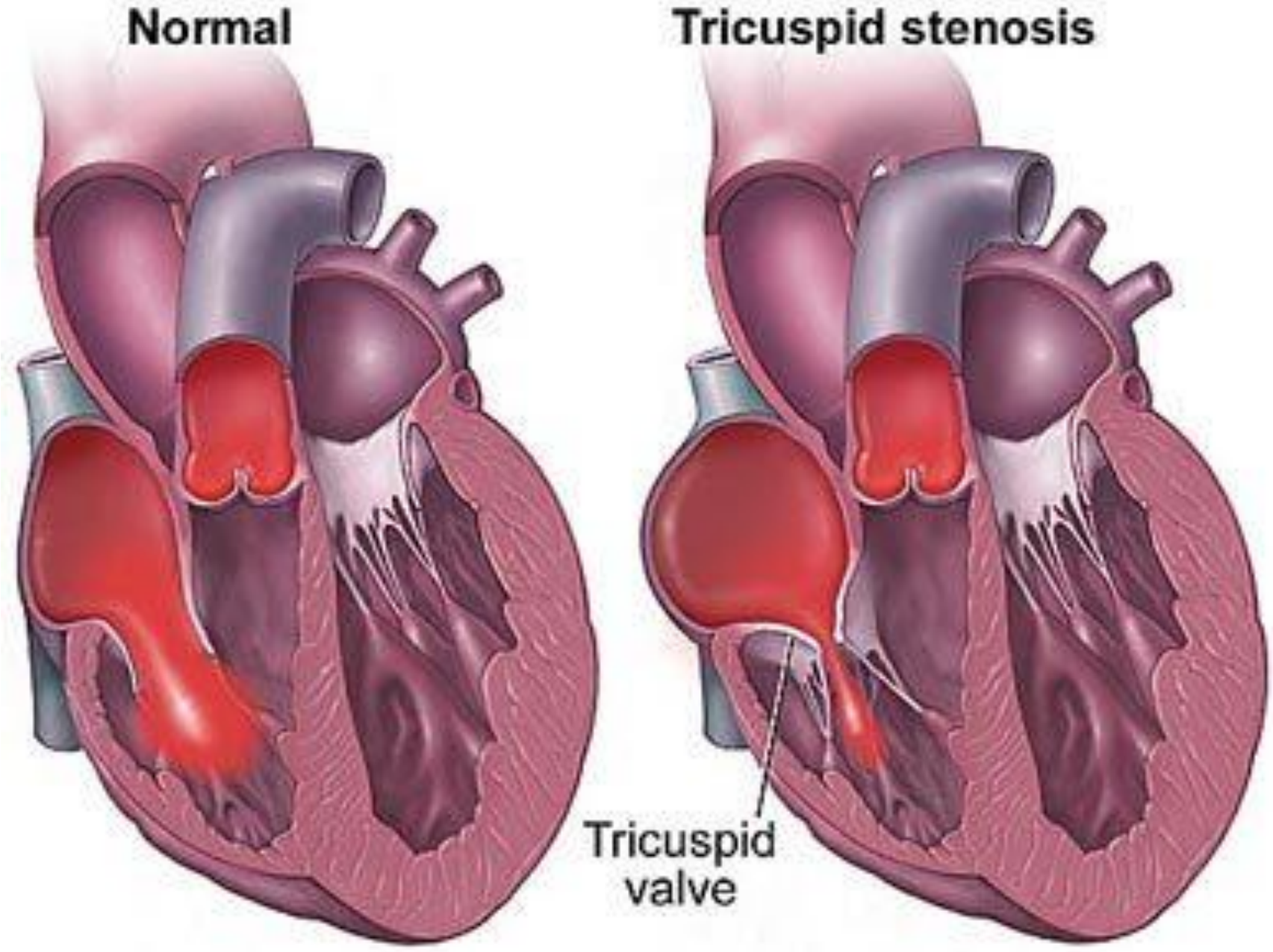
- Bicuspid valve or disproportionate cusps

Acquired

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



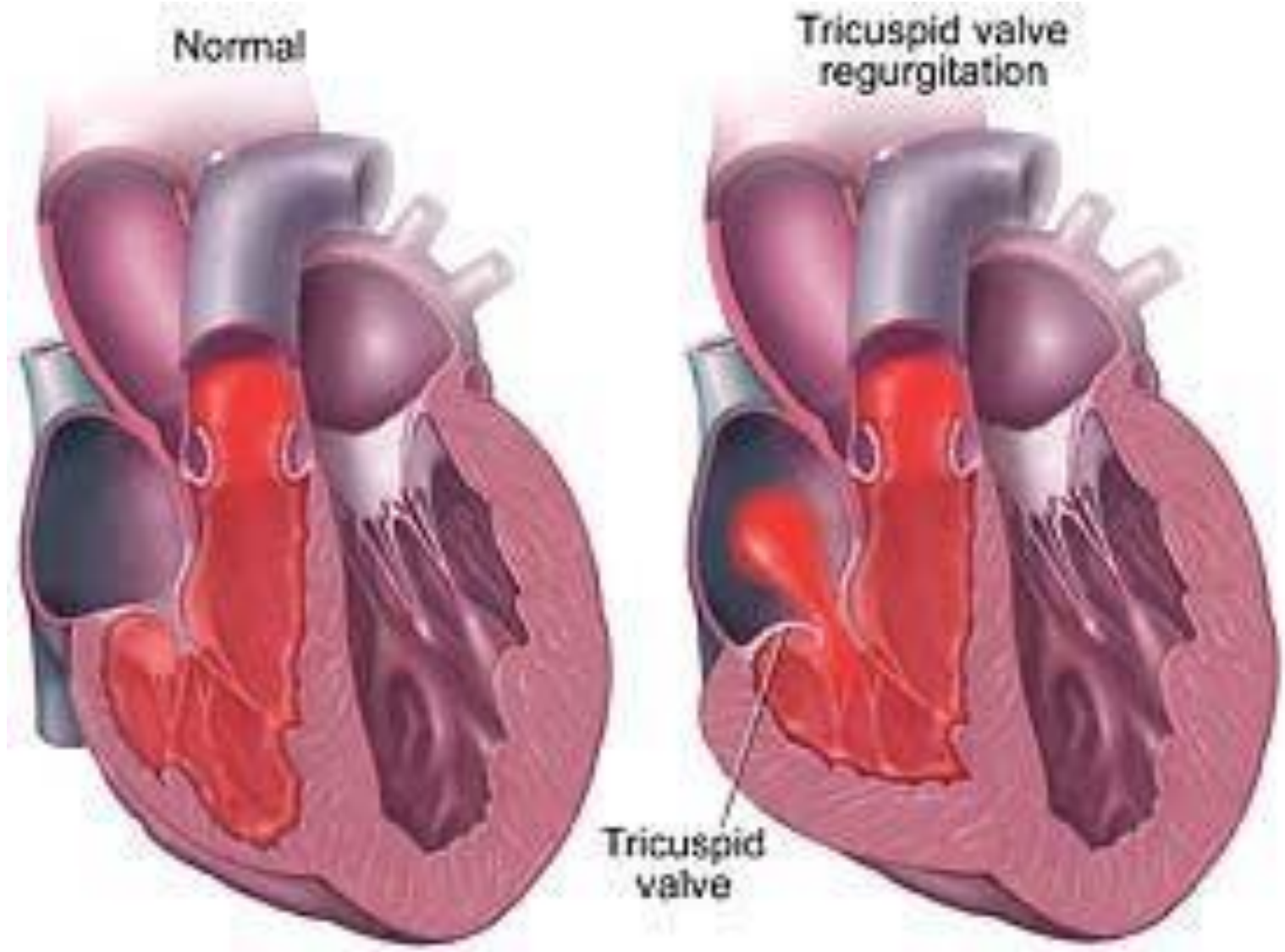
Etiologies of aortic regurgitation


Normal
Tricuspid stenosis
Tricuspid valve

Tricuspid stenosis

Tricuspid stenosis is usually rheumatic in origin and is rare in developed countries. It always occurs in association with mitral and aortic valve disease.

Tricuspid stenosis and regurgitation may also occur in carcinoid syndrome


Normal
Tricuspid valve regurgitation
Tricuspid valve

16.91 Causes of tricuspid regurgitation

Primary

- Rheumatic heart disease
- Endocarditis, particularly in intravenous drug-users
- Ebstein's congenital anomaly (see Box 16.102)

Secondary

- Right ventricular failure
- Right ventricular infarction
- Pulmonary hypertension

Management:

- Patients with asymptomatic and mild valvular disease can be followed up

Indications for intervention	
Symptomatic patients	Severe valve disease
Ventricular dysfunction:	Primary MR , AR , AS → LV Primary TR, PS, PR → RV
Significant Ventricular dilatation :	Primary MR , AR → LV Primary TR, PR → RV
New onset AF	MS , primary MR
Severe pulmonary hypertension	AS, MS , primary MR
Undergoing cardiac surgery (CABG, another valve)	Moderate – severe valve disease
Desire pregnancy	Severe MS , AS

➢ Balloon valvuloplasty (Trans-catheter)

- Suitable morphology MS (not heavily calcified , absence of LA thrombus, less than moderate MR)
- Suitable morphology PS (not dysplastic , less than moderate PR)
- AS with haemodynamic instability as a bridge to aortic valve replacement

➢ Valve repair

❑ Surgical :

- Primary MR especially mitral prolapse
- Primary TR
- Few cases of AR by suitable morphology bicuspid aortic valve

❑ Trans-catheter :

High surgical risk MR

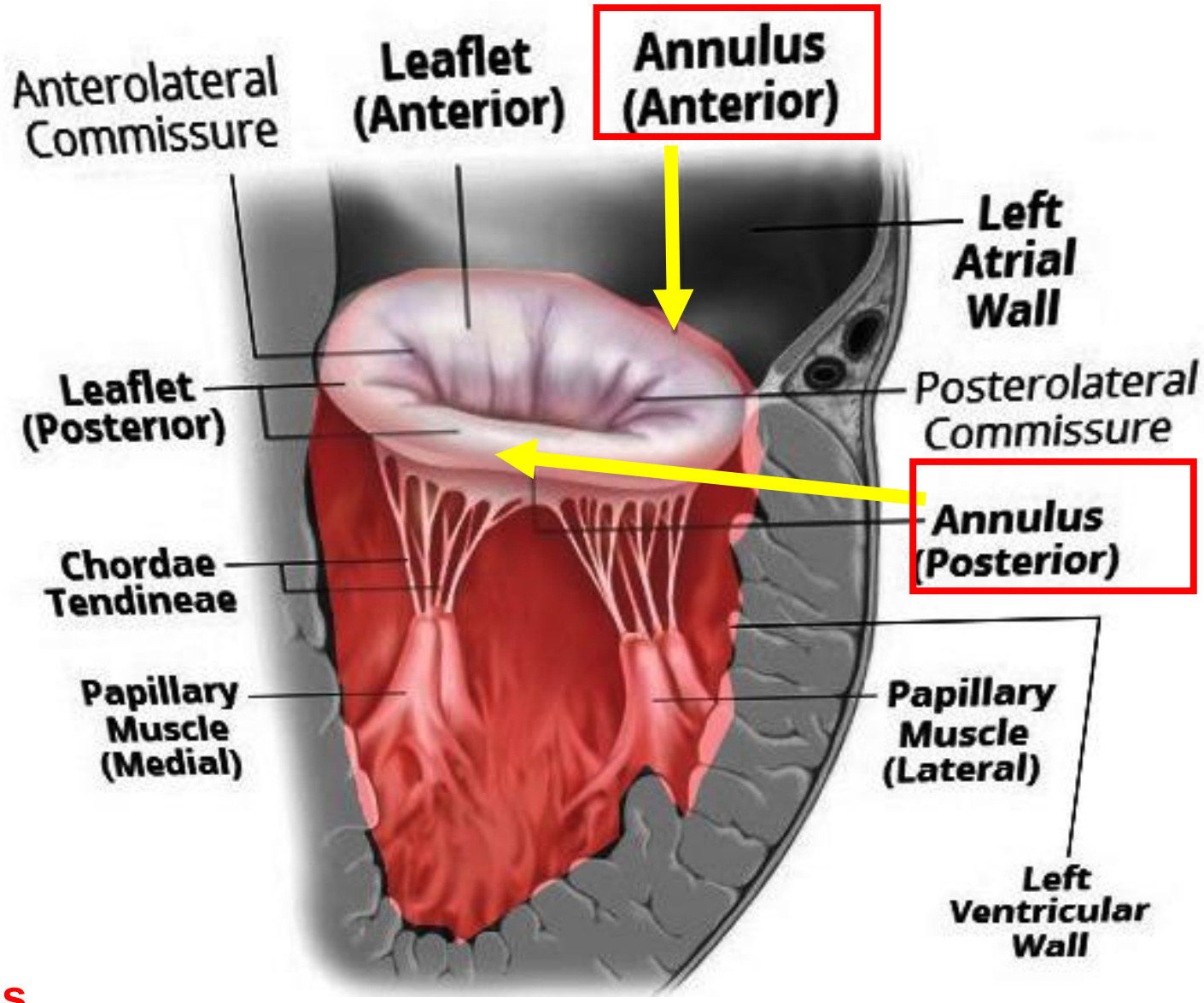
- **Valve replacement**
- Mechanical
    1. Surgical
    2. Trans-catheter : Aortic (TAVI)
- Bio-prosthetic valve (surgical)

https://meet.google.com/zkb-dzps-sgw

- **Aortic root replacement + Aortic valve replacement**

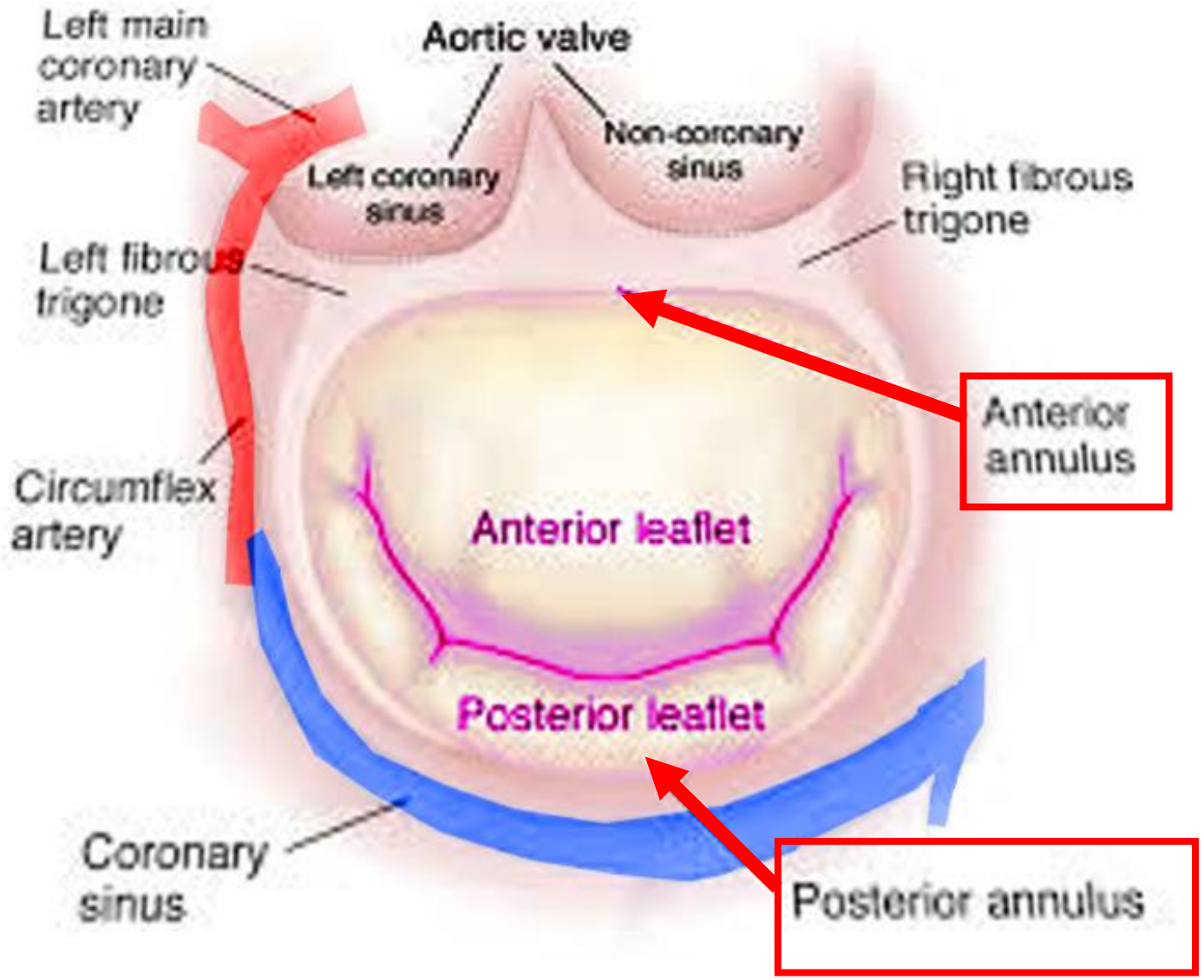
When aortic root dilatation is the cause of AR as can occur in Marfan's syndrome

WHAT IS A SECONDARY MR ?



The mitral annulus

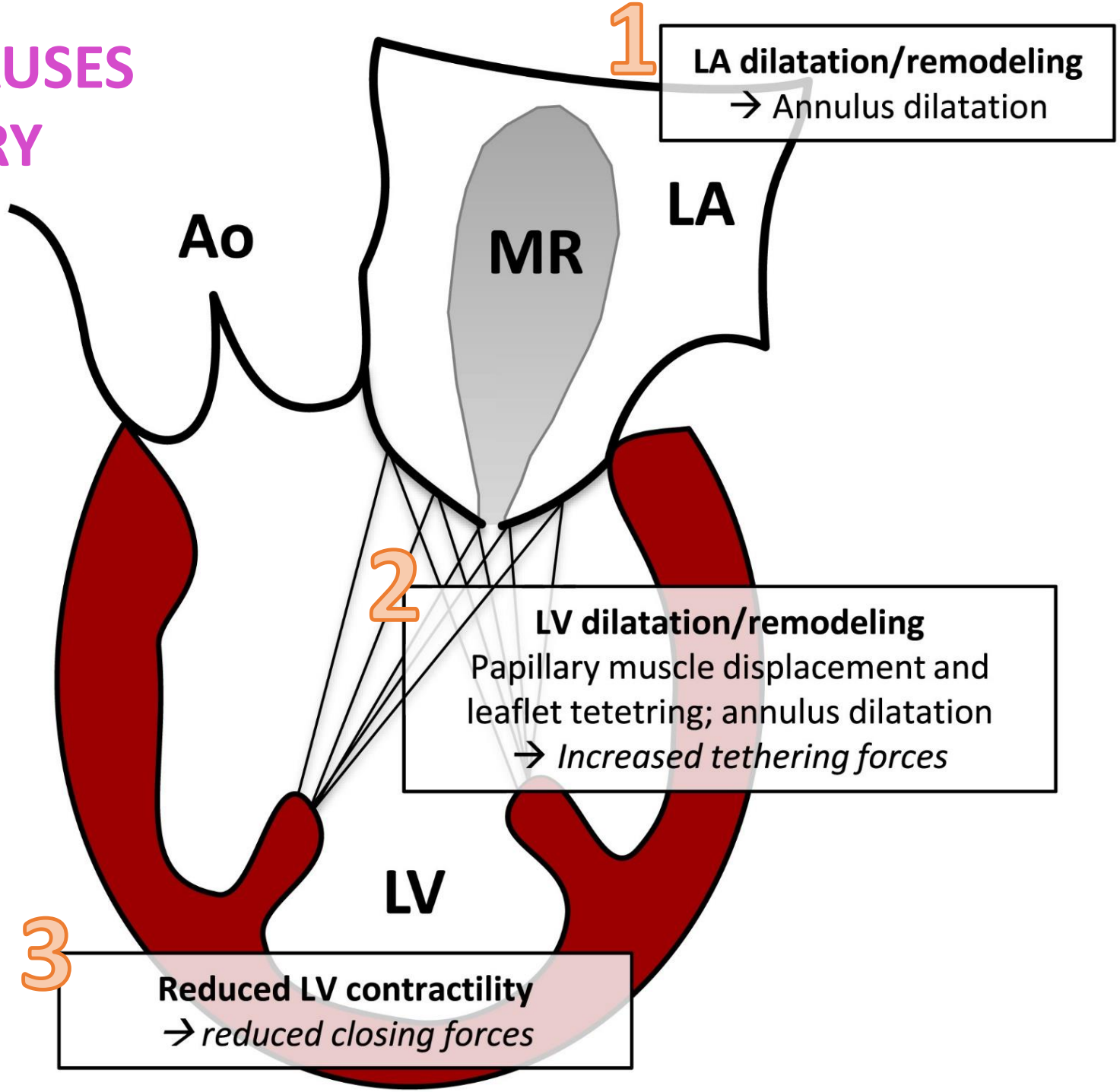
- the anatomical junction between the LV and LA
- serves an insertion site for the leaflet tissue



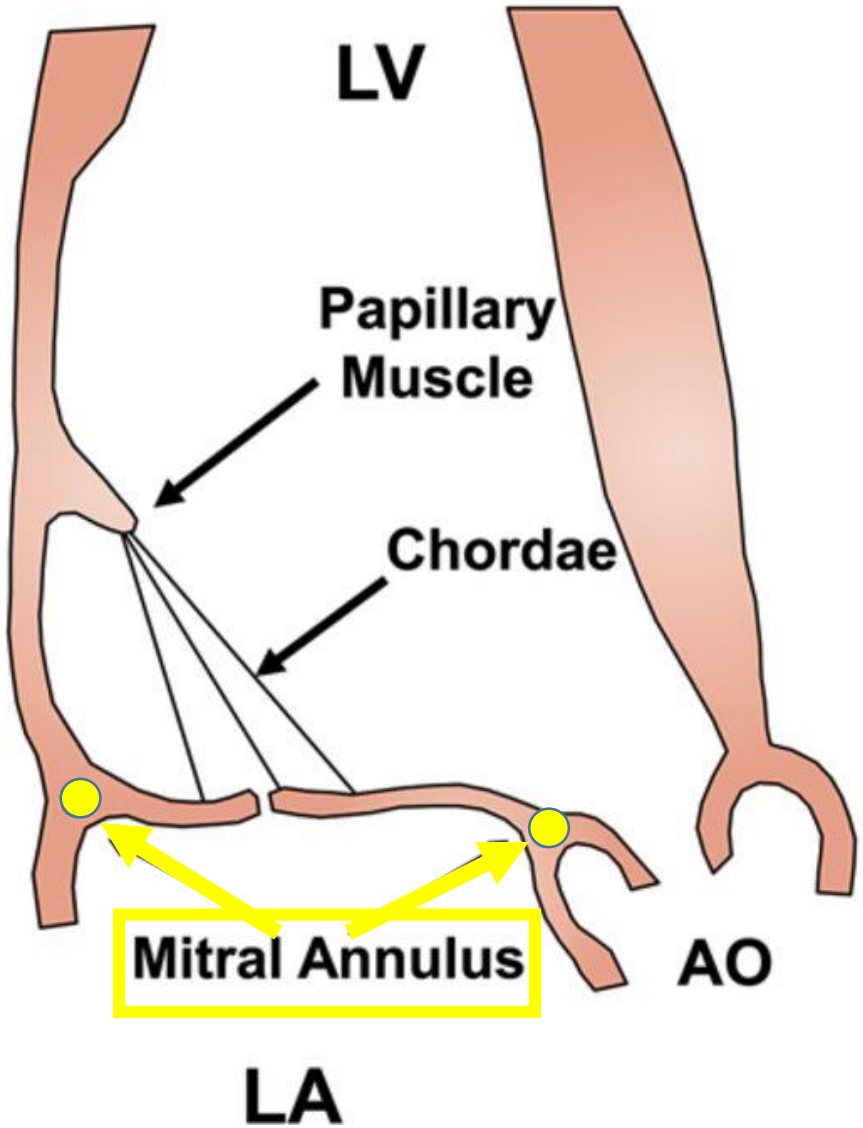
The mitral annulus

- the anatomical junction between the LV and LA
- serves an insertion site for the leaflet tissue

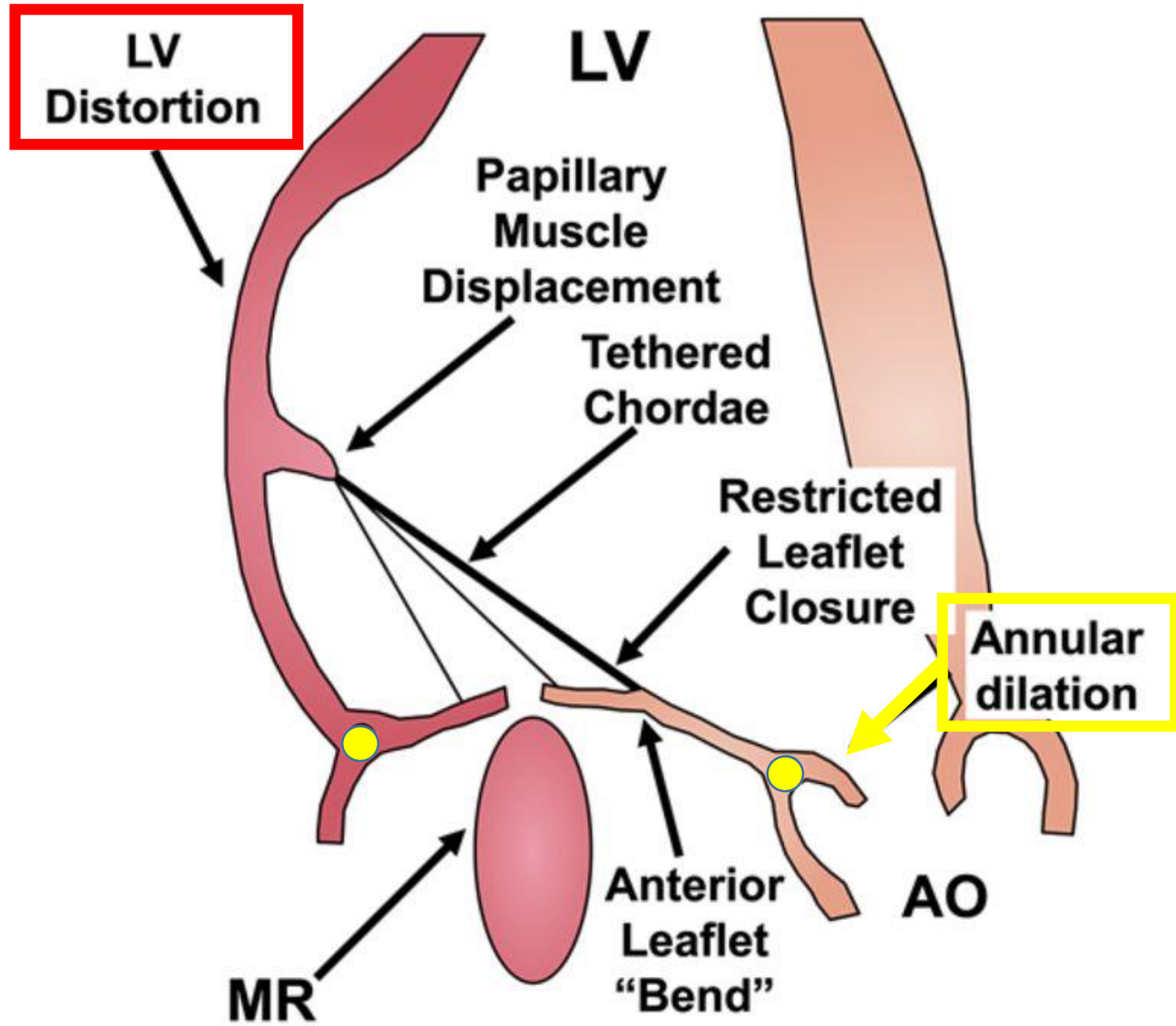
WHAT ARE CAUSES OF SECONDARY MR ?

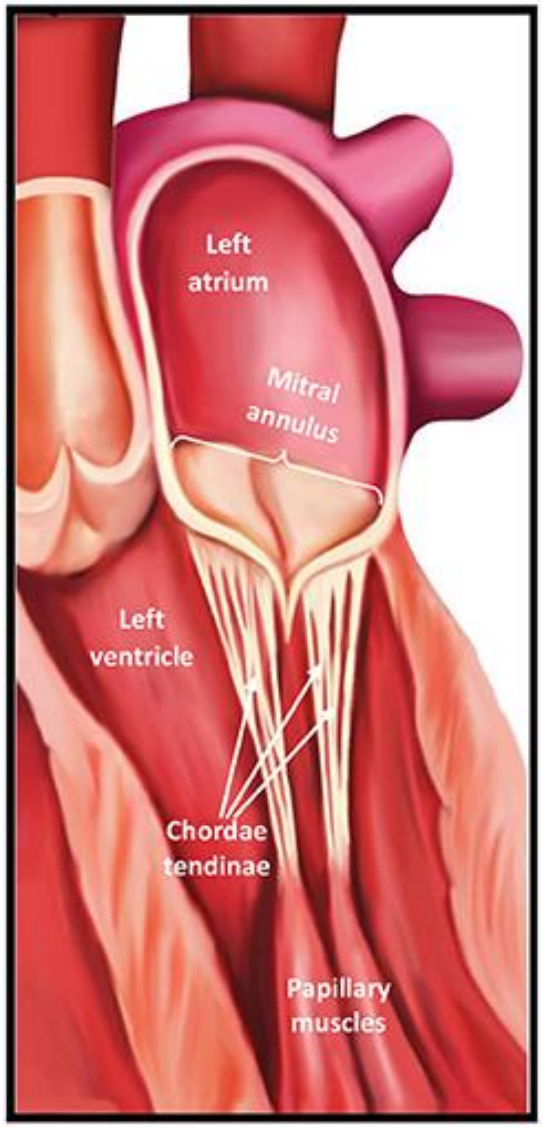


Normal Mitral Valve

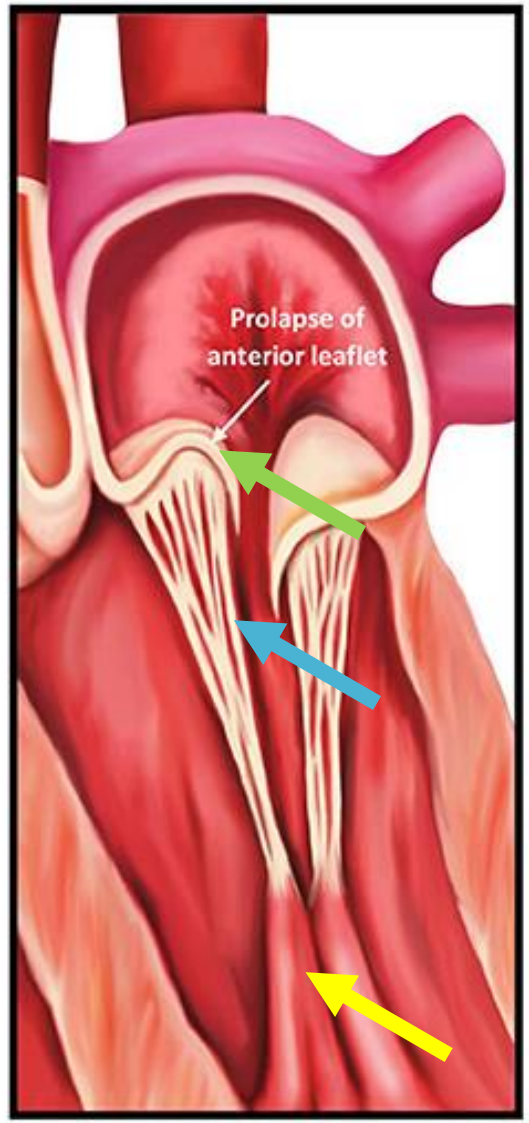


Secondary Mitral Regurgitation

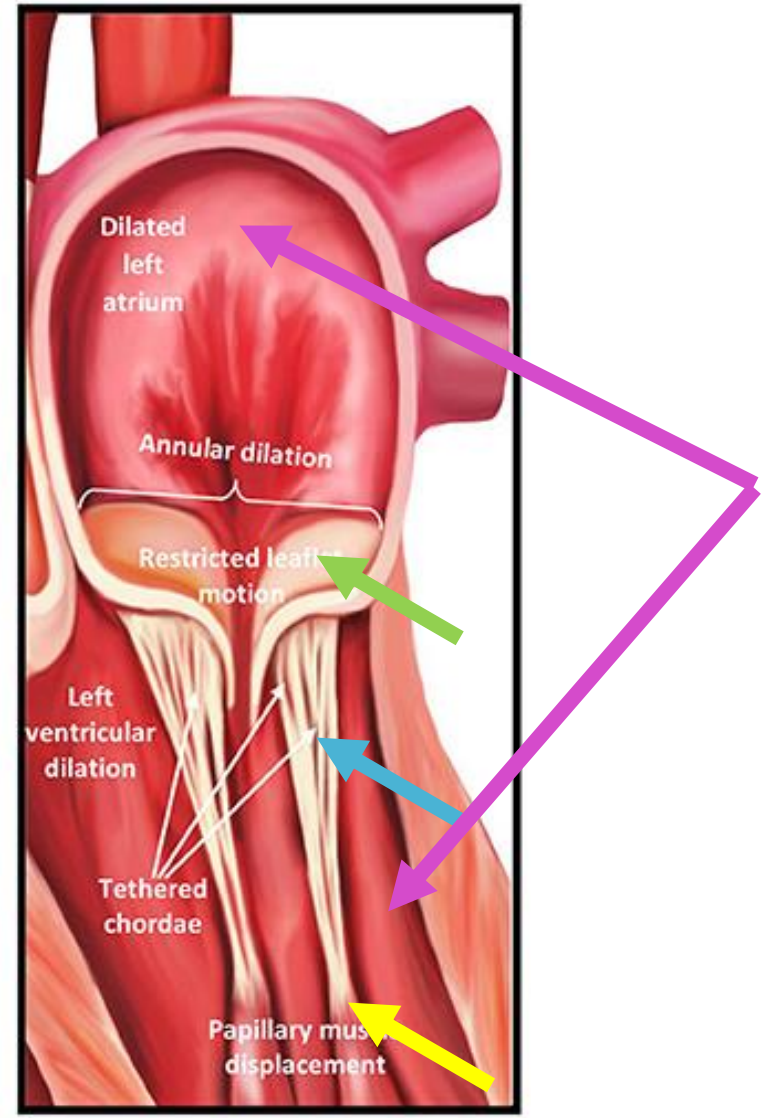




Normal mitral valve anatomy

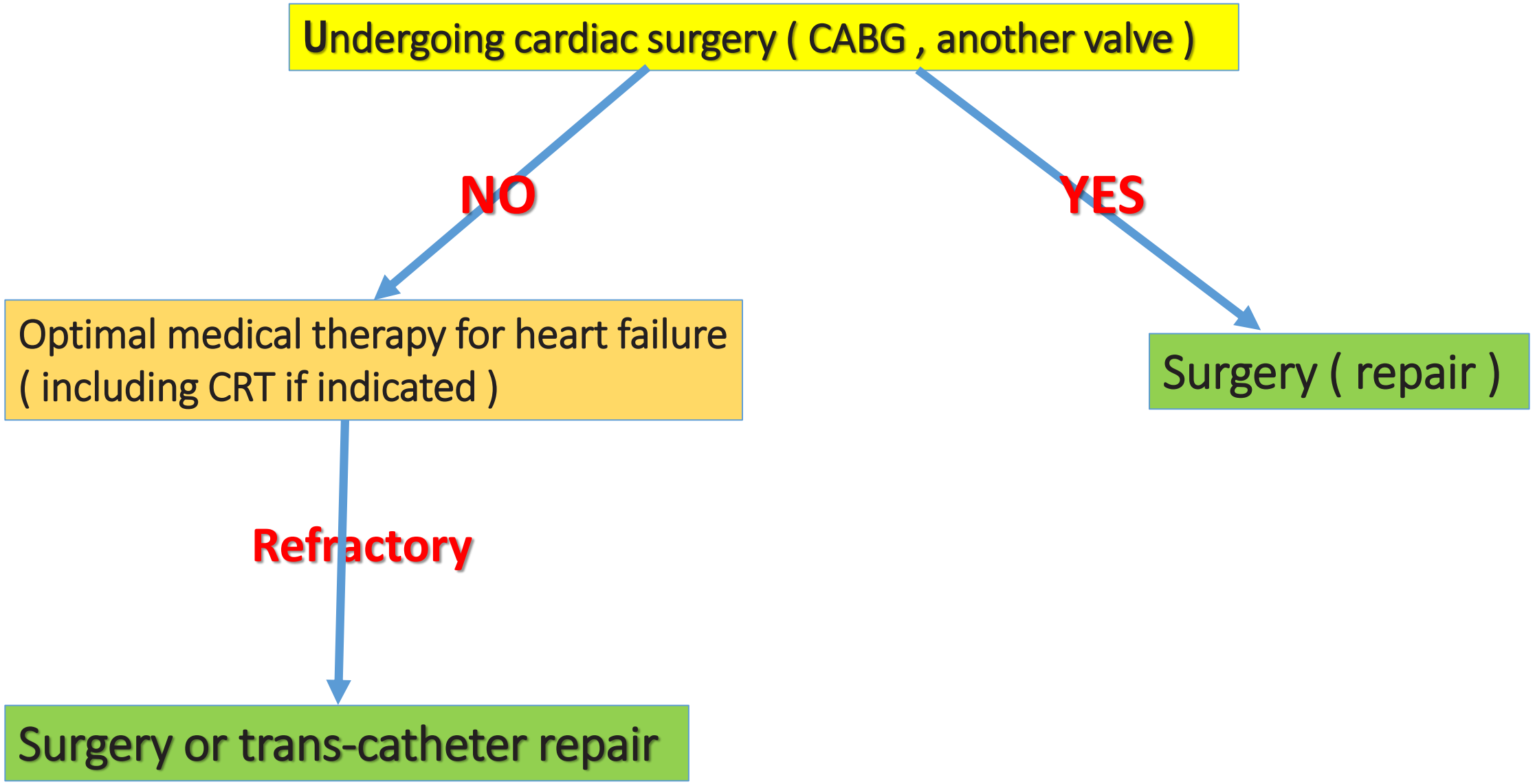


Primary mitral regurgitation due to valve prolapse

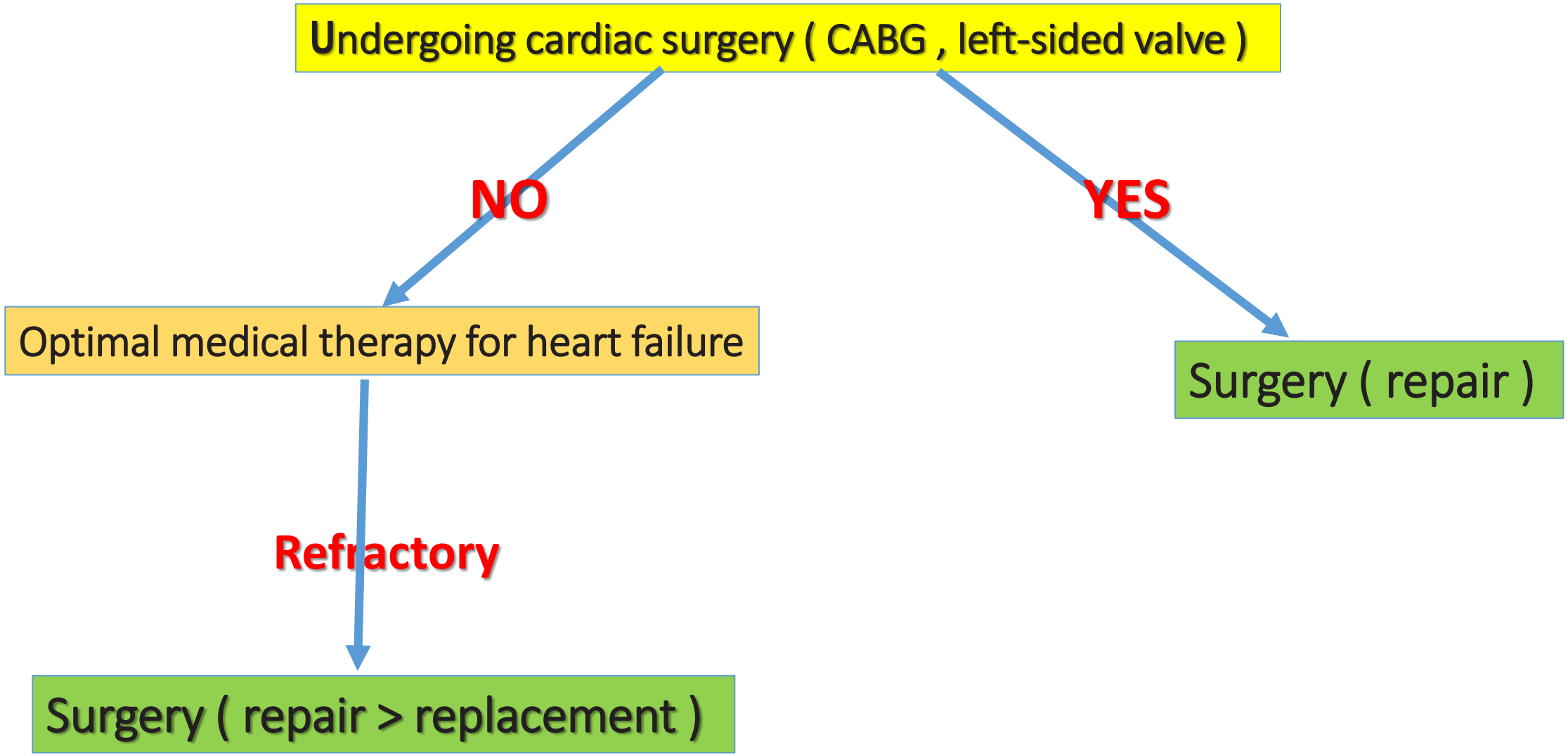


Functional mitral regurgitation

Management of severe secondary MR



Management of severe secondary TR



Medical management in vavular heart disease:

- Treatment may be required for underlying conditions such as endocarditis , aortic dissection

- Treatment of Atrial fibrillation:
  - Anticoagulation (VKA , DOAC except for moderate-severe MS)
  - Rate control : Digoxin, B blockers or rate-limiting calcium channel blockers
  - Rhythm control : few cases are eligible

- Pulmonary oedema &/or volume overload : Loop diuretics

- Treatment of Heart failure with reduced ejection fraction HFrEF

- Systemic hypertension : Vasodilators like ACEI and ARB (cautious in severe aortic stenosis)

(DOAC) direct acting oral anticoagulant ?
advantage and disadvantage vs wafarin

Advantage	Disadvantage
Rapid **onset and offset**	Higher **cost**
Less **intracranial bleeding** and haemorrhagic stroke	More **GI bleeding**
No need for **lab monitoring**	Ineffective for **mechanical heart valves and moderate-severe MS**
Fewer drug-drug and food **interactions**	

Prosthetic Heart Valves

Biologic

- Lasts 8-10 years
- No anticoagulation
- No Click

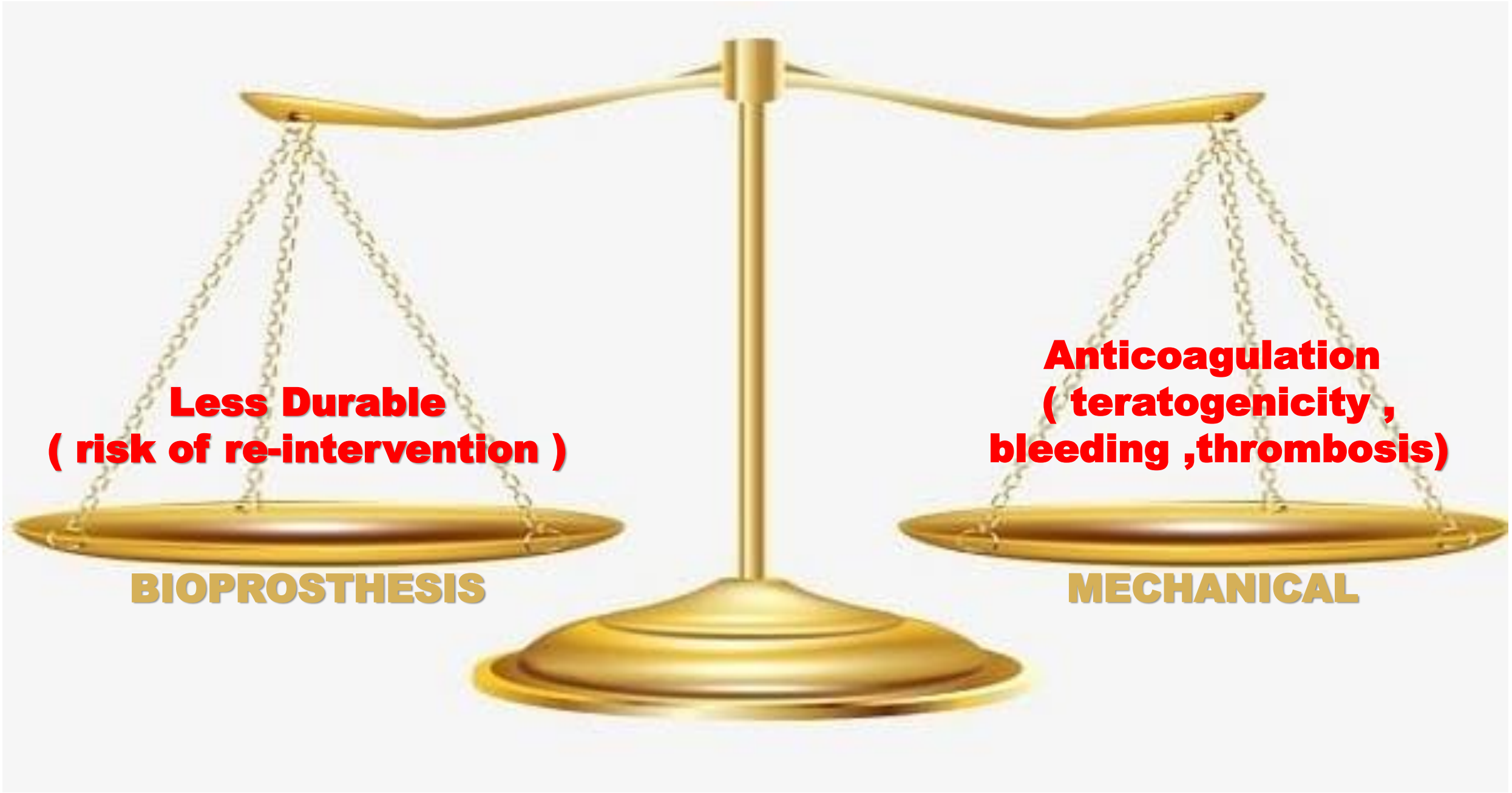
Mechanical

- Lasts > 20 years
- Lifelong anticoagulation
- Click

Choice of prosthetic valve :

- Patient desire
- Age

AGE	Favour mechanical	Borderline age	Favour bioprosthesis
Aortic valve	<60	60-65	>65
Mitral valve	<65	65-70	>70


Less Durable
(risk of re-intervention)
BIOPROSTHESIS
Anticoagulation
(teratogenicity ,
bleeding ,thrombosis)
MECHANICAL

Biological valve :

It is not recommended for :

- **Young age** < 40
- Hyperparathyroidism (**accelerated valve degeneration**)
- **High risk for redo surgery** (prior radiotherapy , porcelain aorta , more than 1 valve , ventricular dysfunction)
- The patient already has **another indication of anticoagulation** e.g. : AF , Venous thromboembolism , other mechanical valve

Mechanical valve :

It is not recommended for :

- Reproductive age female contemplating **pregnancy**
- **High bleeding risk** : high risk occupation , previous major bleeding , poor compliance
- **High thrombotic risk** : Hx of valve thrombosis on adequate anticoagulation , poor compliance , poor adherence
- **Low life expectancy** : less than 10 years