

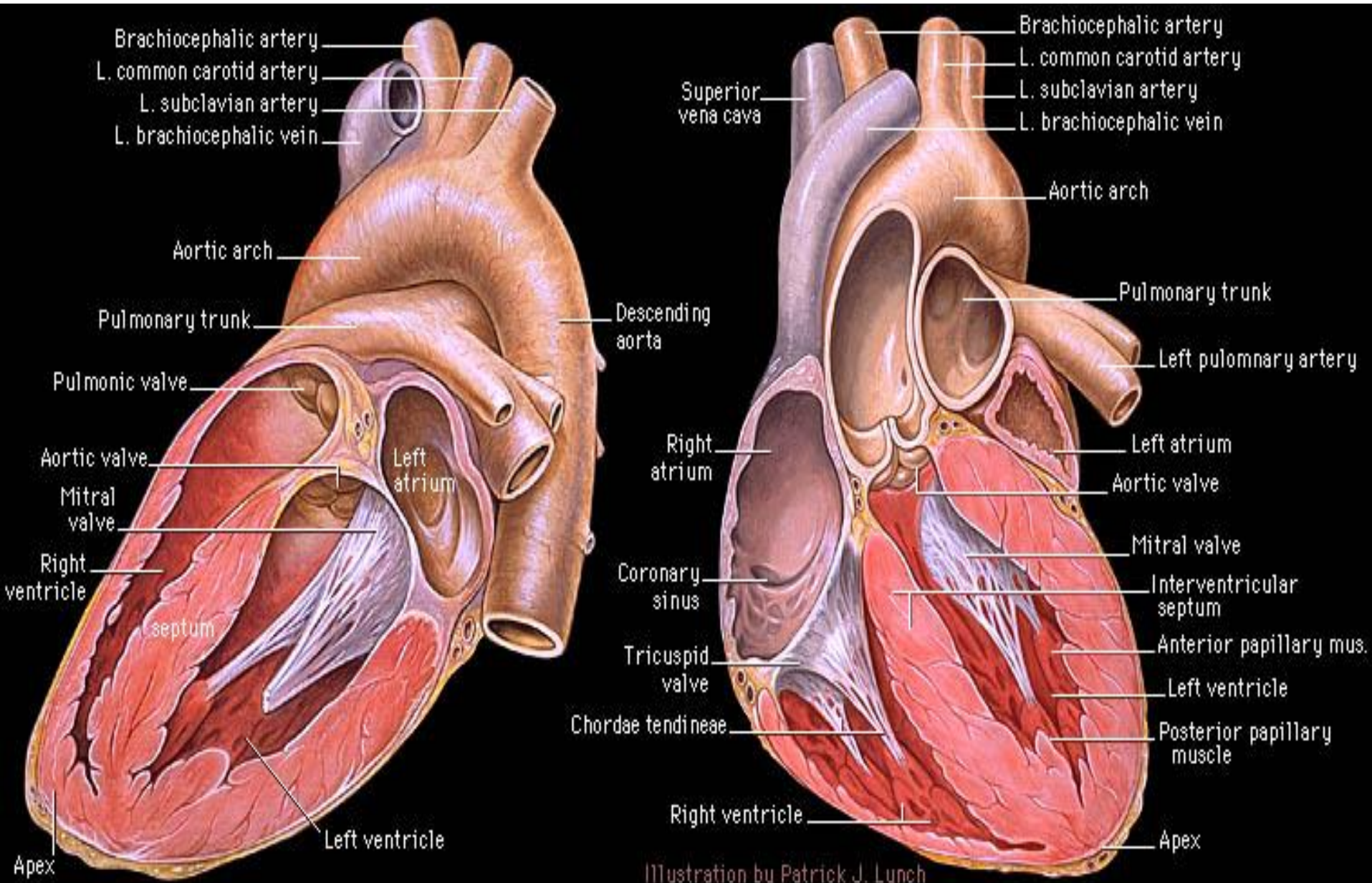
Reference

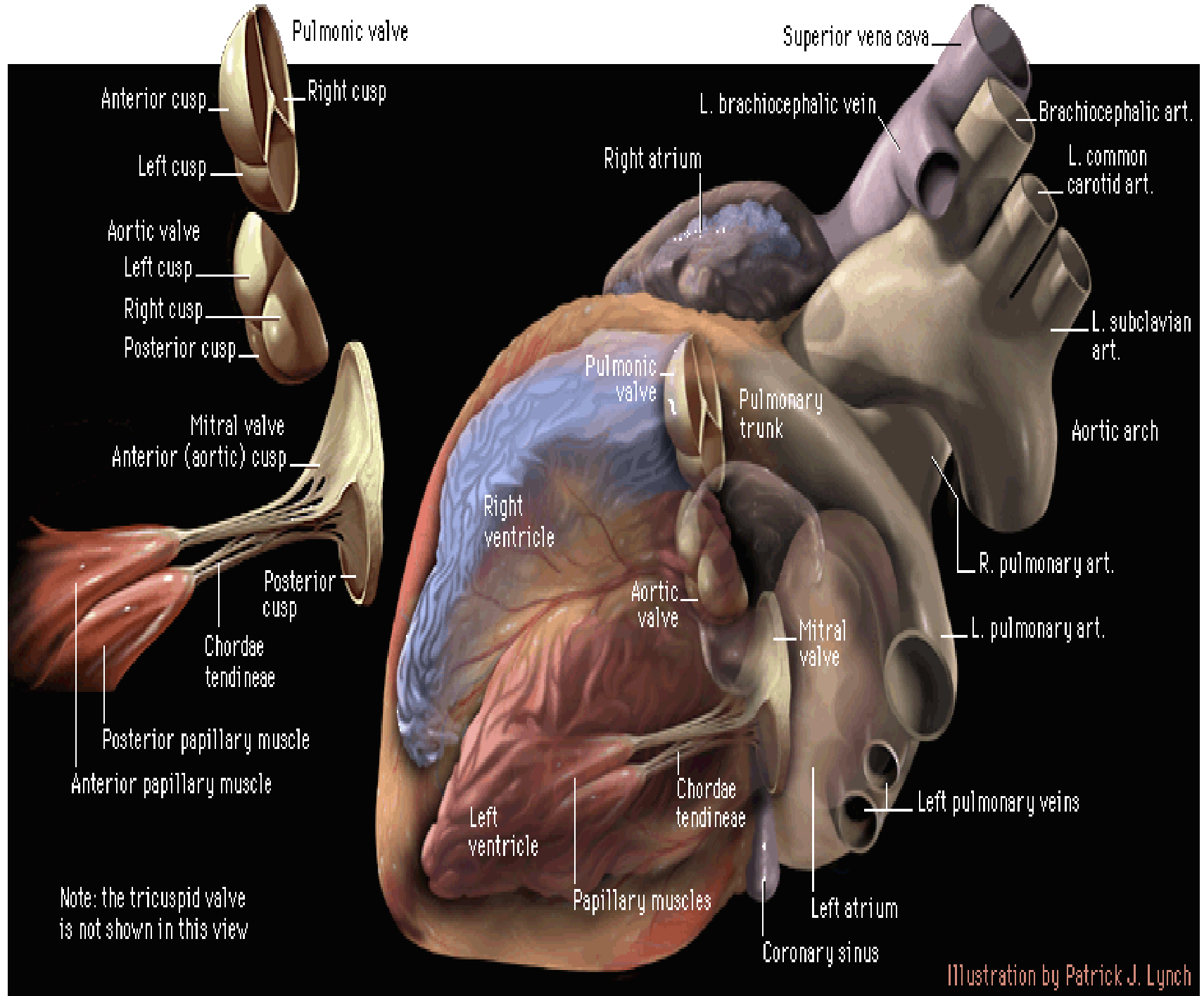
- **Davidson's – Principles and Practice of
Medicine
23st Edition
2014 - 2015
Chapter 18
pages 521 - 640**

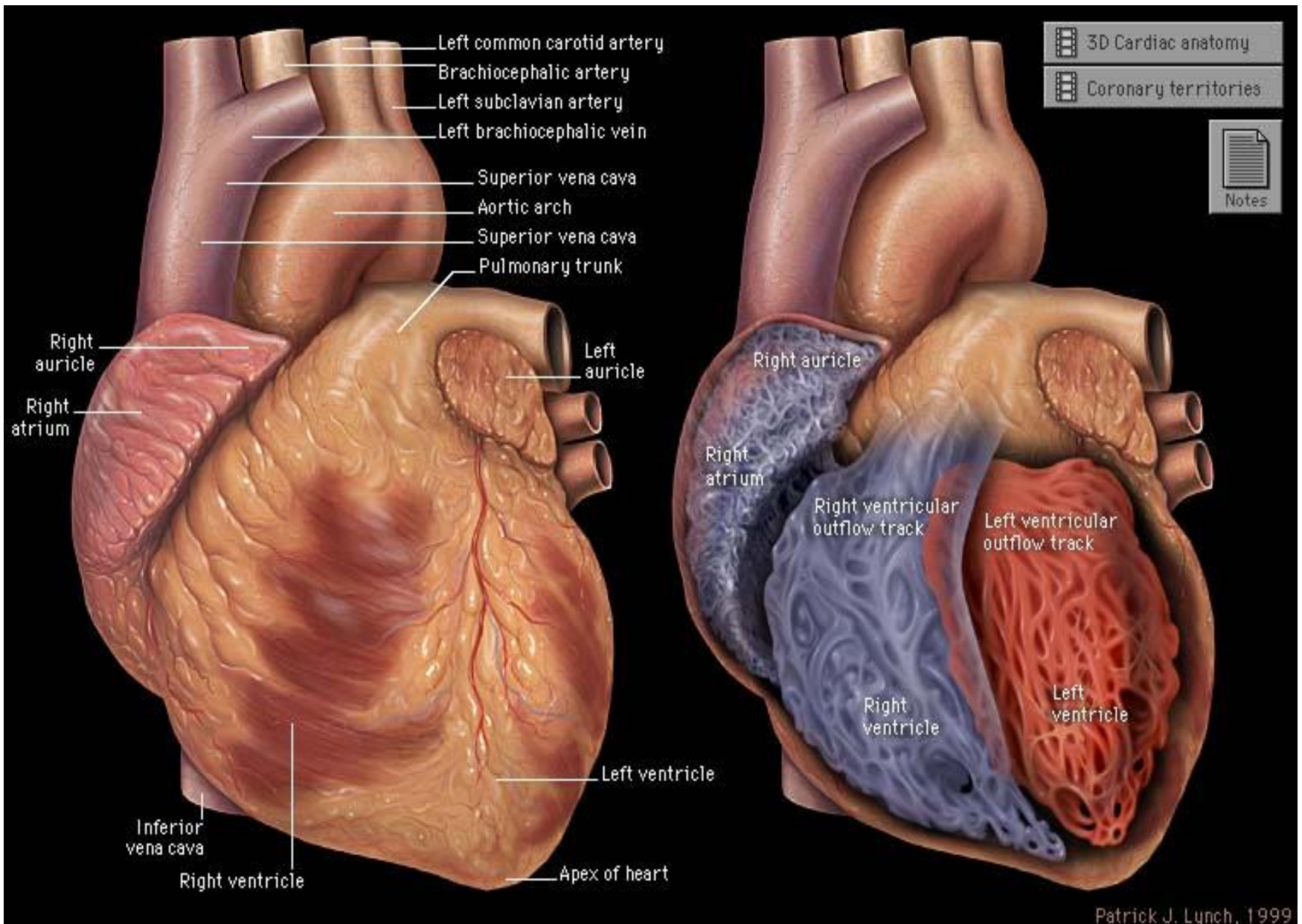


Introduction to CVD

- **Student must have good knowledge of CVS anatomy and Physiology**
- **40% of all deaths at least in worldwide are attributed to CV diseases.**
- **No. of CV deaths exceeds No. of deaths from ALL malignancies and accidents.**







Anatomy of the heart

- The heart acts as two separate pumps operating side by side; the right heart generates the circulation to the lungs and the left heart feeds the rest of the body.
- The RA drains deoxygenated blood from SVC and IVC and discharges blood to the RV, which in turn pumps it into the PA. The LA drains oxygenated blood from the lungs to the LV.
- The systolic pressure in the LV is normally at least four times greater than that in the right, and the wall of the LV is usually at least 1 cm thick compared with 2-3 mm for the RV.

Physiology of the heart

- The basic unit of contraction is the **sarcomere**, which is aligned to those of adjacent myofibrils.
- **Actin** filaments are attached and interdigitate with thicker parallel **myosin** filaments.
- During **contraction**, shortening of the sarcomere results from the **interdigitation of the actin and myosin molecules**.
- The force of cardiac muscle contraction, or inotropic state, is regulated by the influx of **calcium ions** through 'slow calcium channels'.

Endothelial Function

- **Vasodilators**

Nitric Oxide

Prostacyclin

Endothelium derived Hyperpolar
Factor

- **Vasoconstrictors**

Endothelin – I

Angiotensin – II

- * **Formation & Disolution of Thrombus**

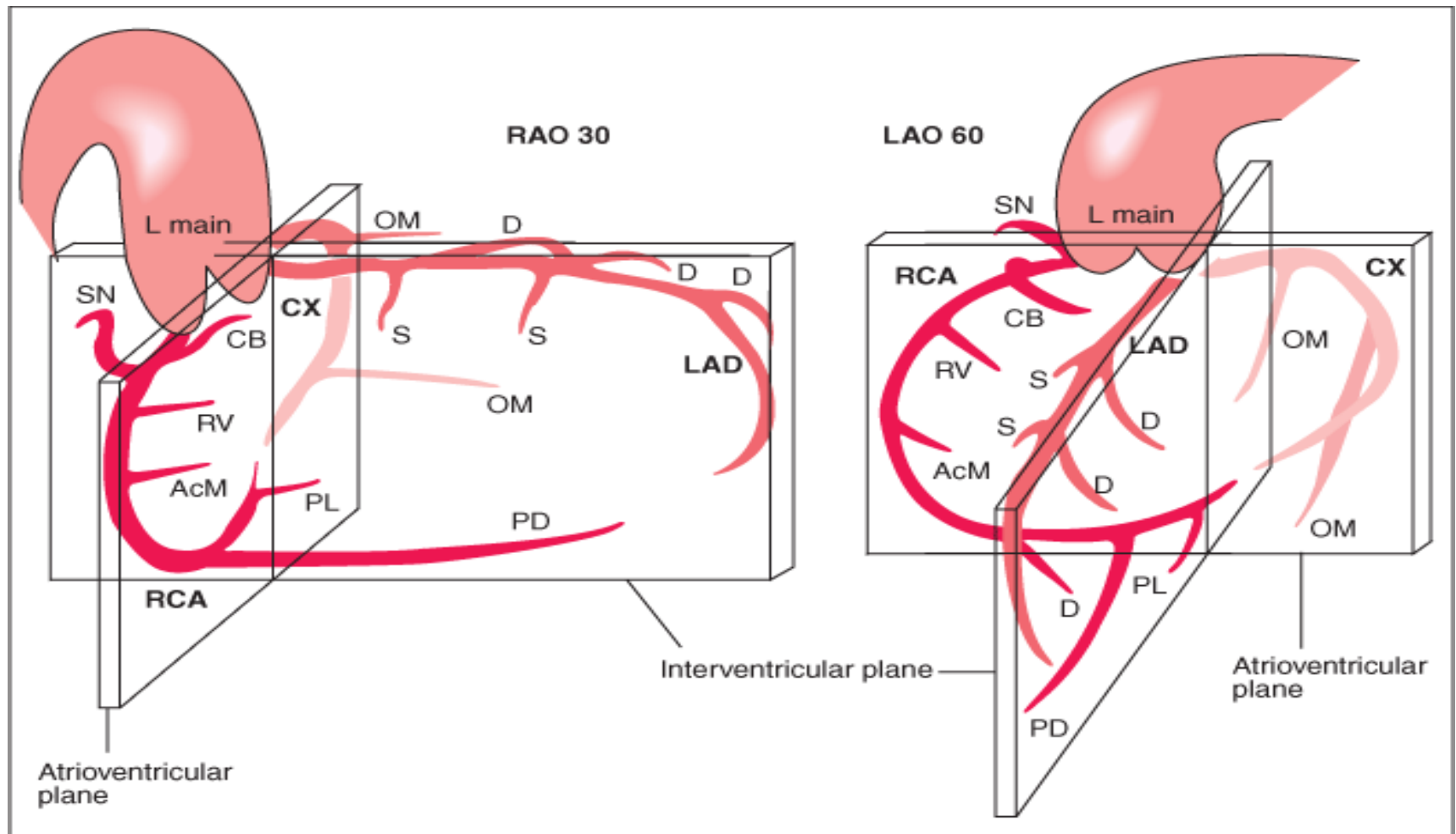
Haemodynamic effects of respiration

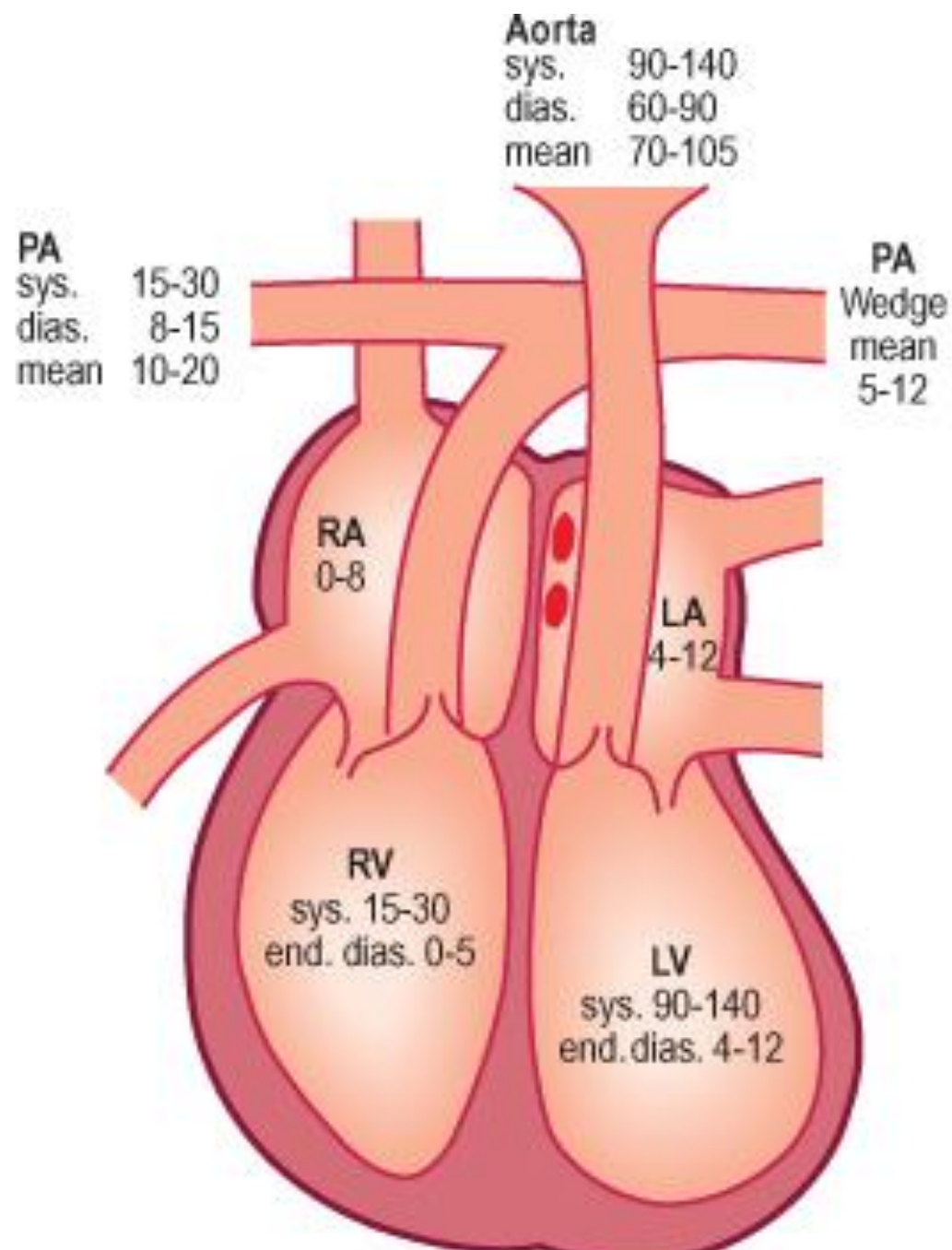
- | | Inspiration | Expiration |
|---------------------------|-------------|------------|
| • Jugular venous pressure | Falls | Rises |
| • Blood pressure | Falls | Rises |
| • Heart rate | Accelerates | Slows |
| • Second heart sound | Splits | Fuses |
- **Inspiration** prolongs RV ejection, delaying P2, and shortens LV ejection, bringing forward A2; **expiration** produces the opposite effects.

Nerve supply of the heart

- The heart is innervated by both **sympathetic** and **parasympathetic** fibers.
- Positive inotropic and chronotropic effects are mediated by B1-adrenoceptors, whereas B2-adrenoceptors predominate in vascular smooth muscle and mediate vasodilatation.
- Under resting conditions, vagal inhibitory activity predominates and the heart rate is slow.
Adrenergic stimulation associated with exercise, emotional stress, fever and so on causes the heart rate to increase.

Coronary Circulation





Normal pressure values (Left Side)- mm

- **Arterial Peak Systolic** **90-140**
- **Arterial end-diastolic** **60-90**
- **Arterial mean** **70-105**
- **LV Peak Systolic** **90-140**
- **LV End diastolic** **4-12**
- **LA - mean** **4-12**

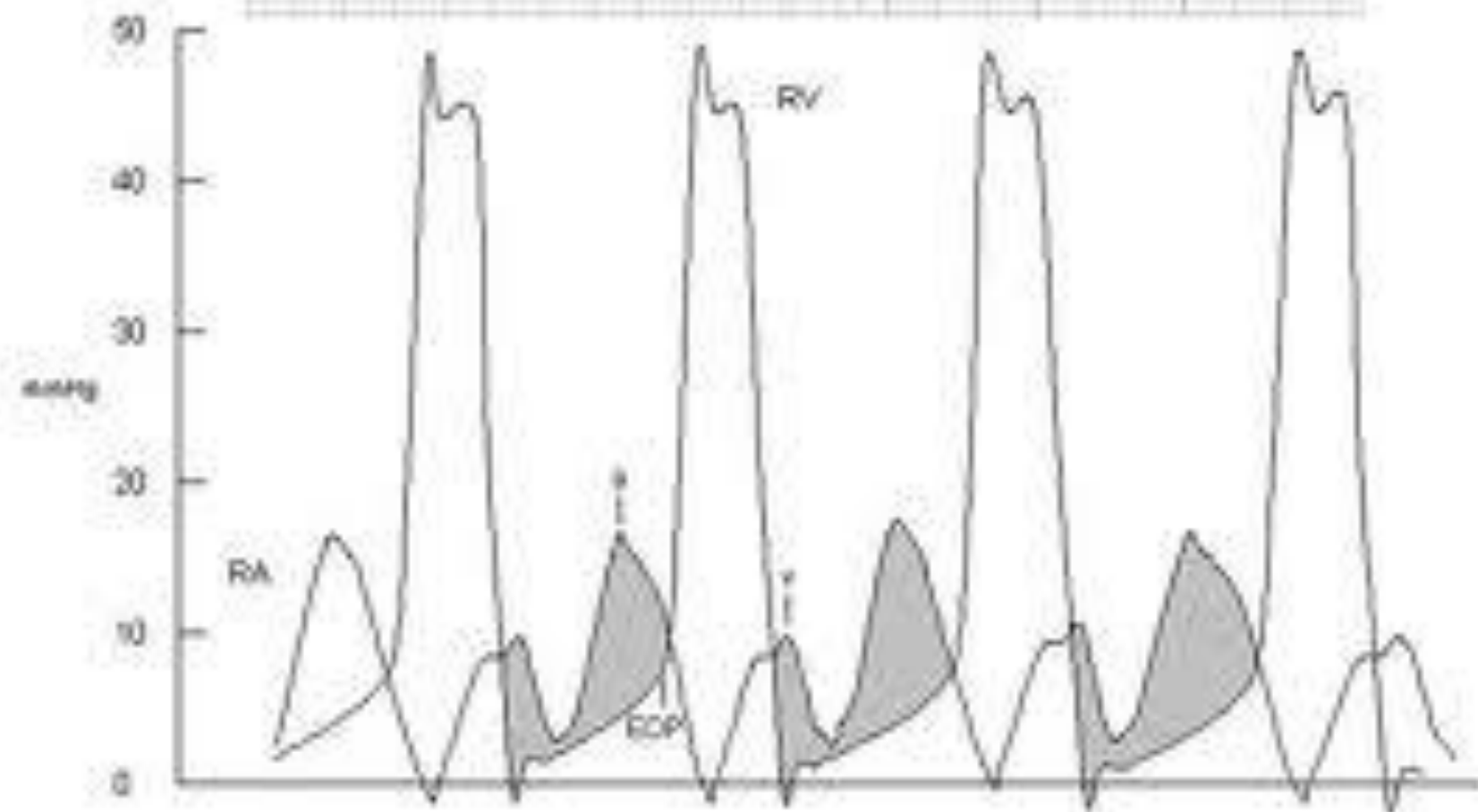
Normal pressure values (Right side) - mm

- **Pulm.Art.Peak Systolic** **15-30**
- **Pulm.Art.End Diastolic** **5-15**
- **Pulm.Art.Mean** **10-20**
- **RV Peak Systolic** **15-30**
- **RV End Diastolic** **0-5**
- **RA Mean** **0-5**

Common symptoms of heart disease

- **Chest discomfort**
 - Angina
 - Myocardial infarction
 - Pericarditis
 - Aortic dissection
- **Breathlessness**
 - Heart failure
 - Angina
 - Pulmonary embolism
 - Pulmonary hypertension
- **Palpitation**
 - Tachyarrhythmias
 - Ectopic beats
- **Syncope/dizziness**
 - Arrhythmias
 - Simple faints ,Postural hypotension ,Aortic stenosis ,Hypertrophic obstructive cardiomyopathy , Atrial myxoma
- **Oedema**
 - Heart failure
 - Constrictive pericarditis

ECG



Bilateral oedema

- Heart failure
- Chronic venous insufficiency
- Hypoproteinaemia, e.g. nephrotic syndrome, kwashiorkor, cirrhosis
- Lymphatic obstruction, e.g. pelvic tumour, filariasis
- Drugs, e.g. non-steroidal anti-inflammatory drugs, nifedipine, amlodipine, fludrocortisone
- Inferior vena caval obstruction
- Thiamine deficiency (wet beri-beri)
- Milroy's disease (more common in females, unexplained lymphoedema which appears at puberty)
- Immobility

Normal pulse

- Normal pulse rate is between 60-100 b.p.m.
- Bradycardia is a pulse rate of < 60 b.p.m
- Tachycardia > 100 b.p.m
- Assess the pulse in the context of the situation eg a rate of 50 may be normal in a fit young person, and a rate of 65 may be abnormal in acute heart failure.



Character of pulse

- Slow rising- aortic stenosis-AS
- Collapsing- aortic regurgitation-AR
- Bisferiens- AR & AS
- Pulsus paradoxus- heart sounds heard, but no radial pulse- seen with cardiac tamponade or severe asthma
- Pulsus alternans- alternate strong & weak beats- seen in severe LVF

- Pulsus paradoxus – occurs when the pulse pressure falls by $>10\text{mm hg}$ with each inspiration, found in constrictive pericarditis & cardiac tamponade.
- Bisferiens pulse (biphasic pulse) – with 2 systolic peaks is usually attributed to a combination of aortic stenosis & aortic regurgitation.

Bisferiens pulse (2 systolic peaks)

- 1st peak – occurs as pulse wave upstroke rises rapidly and forcefully (percussion wave)
- A brief decline in pressure follows because of the sudden decrease in the rate of Left ventricular ejection during midsystole, when severe obstruction develops.
- 2nd peak – smaller and slowly rising positive pulse wave (tidal wave) produced by continued ejection and by reflected waves from periphery

DICROTIC PULSE



--Results from the accentuated diastolic dicrotic wave that follows the dicrotic notch.

--It tends to occur when the dicrotic notch is low, as in patients with decreased systemic arterial pressure and vascular resistance (eg, fever).

--In severe heart failure, hypovolemic shock, cardiac tamponade, conditions associated with a decreased stroke volume and elevated systemic vascular resistance.

--During the immediate postoperative period following aortic valve replacement, mechanism is not clear; it is more frequently observed in patients with pump failure postoperatively.

--Dicrotic pulse is occasionally noted in normal individuals, particularly after exercise.

--A dicrotic pulse is frequently **confused with** pulsus bisferiens at the bedside; it is almost impossible to distinguish between these two types of pulse configurations without a pulse recording. Thus, the potential exists for mistaken diagnosis of aortic regurgitation due to malfunction of a prosthetic valve.

Tachycardia

- **Sinus tachycardia**
 - Exercise
 - Pain
 - Excitement/anxiety
 - Fever
 - Hyperthyroidism
- **Arrhythmia**
 - Atrial fibrillation
 - Atrial flutter
 - Supraventricular tachycardia
 - Ventricular tachycardia

Bradycardia

- **Sinus bradycardia**
- Sleep
- Athletic training
- Hypothyroidism
- Medication:
 - beta-blockers
 - digoxin
 - verapamil, diltiazem
- **Arrhythmia**
- Carotid sinus hypersensitivity
- Sick sinus syndrome
- Second-degree heart block
- Complete heart block

Major cardiovascular Symptoms

- Dyspnea – Class I - IV
- Chest Pain (Site , Radiation , Character provoked by , Relived by , Onset , associated Symptoms)
- Oedema & Ascites
- Fatigue
- Palpitation
- Syncope
- Intermittent claudication

CV Physical Exam.

- **Pulse, Neck veins, Heart examination, Peripheral pulses & BP.**
- **General appearance, cyanosis, oedema**
- **Hand examination**
- **Chest (bilateral rales)**
- **Abdomen (Ascites, hepatomegaly)**
- **Neurological exam. & Fundi**



▲ Poor oral hygiene in a patient with infective endocarditis

Central cyanosis
Malar flush
Dental caries
Fundi (retinopathy)
Stigmata of hyperlipidaemia and thyroid disease



▲ Malar flush



▲ Xanthelasma

Jugular venous pulse
(see opposite)
Height
Waveform



▲ Jugular venous pulse

Carotid pulses
Volume
Character
Bruit
(see opposite)

Blood pressure

Radial pulse
Rate
Rhythm

Hands
Clubbing

Splinter haemorrhages and other stigmata of infective endocarditis



▲ Splinter haemorrhage



▲ Cyanosis and clubbing in a patient with complex cyanotic congenital heart disease

Observation

Symptoms and well-being

- Breathlessness
- Distress etc.

Body habitus

- Body mass (obesity, cachexia)
- Marfan's and other syndromes

Tissue perfusion

- Skin temperature
- Sweating
- Urine output

7 Precordium

Inspect
Palpate
(see opposite)

8 Auscultation

(see opposite)

9 Back

Lung crepitations
Sacral oedema

10 Abdomen

Hepatomegaly
Ascites
Aortic aneurysm
Bruit

11 Tendon xanthomas (hyperlipidaemia)



12 Femoral pulses

Radio-femoral delay
Bruit

13 Legs

Peripheral pulses
Oedema



▲ Vasculitis in a patient with infective endocarditis



▲ Peripheral oedema in a patient with congestive cardiac failure

Abnormalities of the jugular venous pulse

- Heart failure
- Pulmonary embolism
- Pericardial effusion
- Pericardial constriction
- Superior vena caval obstruction
- Atrial fibrillation
- Tricuspid stenosis
- Tricuspid regurgitation

Examine patient with high blood pressure

1. Check the pulse rate-irregularly irregular suggests atrial Fibrillation.
2. Measure the blood pressure in both arms.
3. Check for radiofemoral delay (coarctation of the aorta).
4. Examine the optic fundi for hypertensive retinopathy.
5. Look for features of Cushing's syndrome or virillization.
6. Examine the heart for the heave of LVH and for fourth Heart sound.
7. Look for evidence of heart failure.
8. Palpate the abdomen for renal enlargement and abnormal pulsation of an abdominal aortic aneurysm.
9. Listen for bruits over the renal arteries(R.artery stenosis)

Cardiovascular Investigations

1. ECG

Standard 12 leads

Exercise (Stress) ECG...

(Ergometry , Treadmill)

Ambulatory ECG (Holter)

2. Cardiac Biomarkers ,

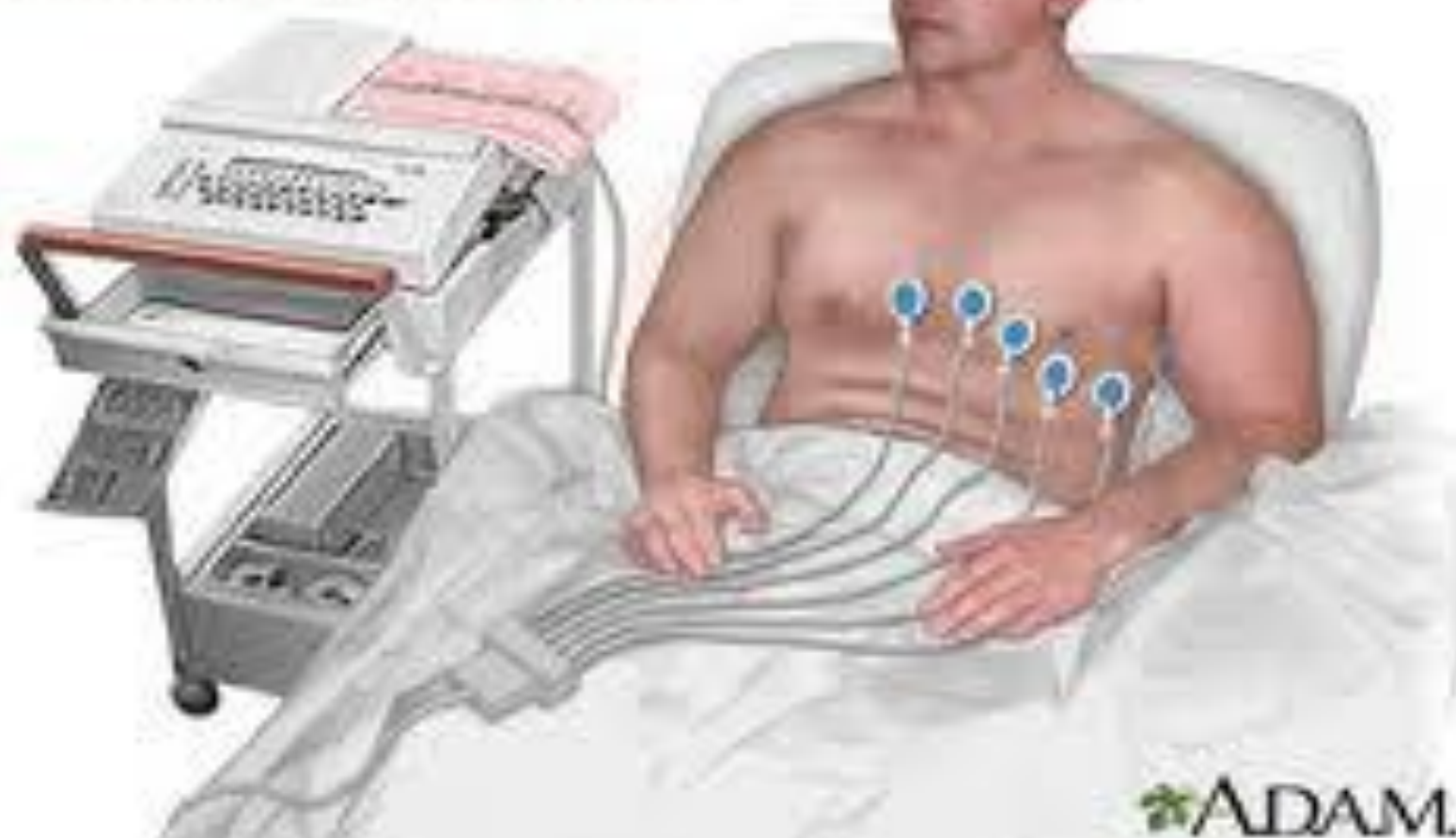
Brain Natriuretic Peptide (BNP)

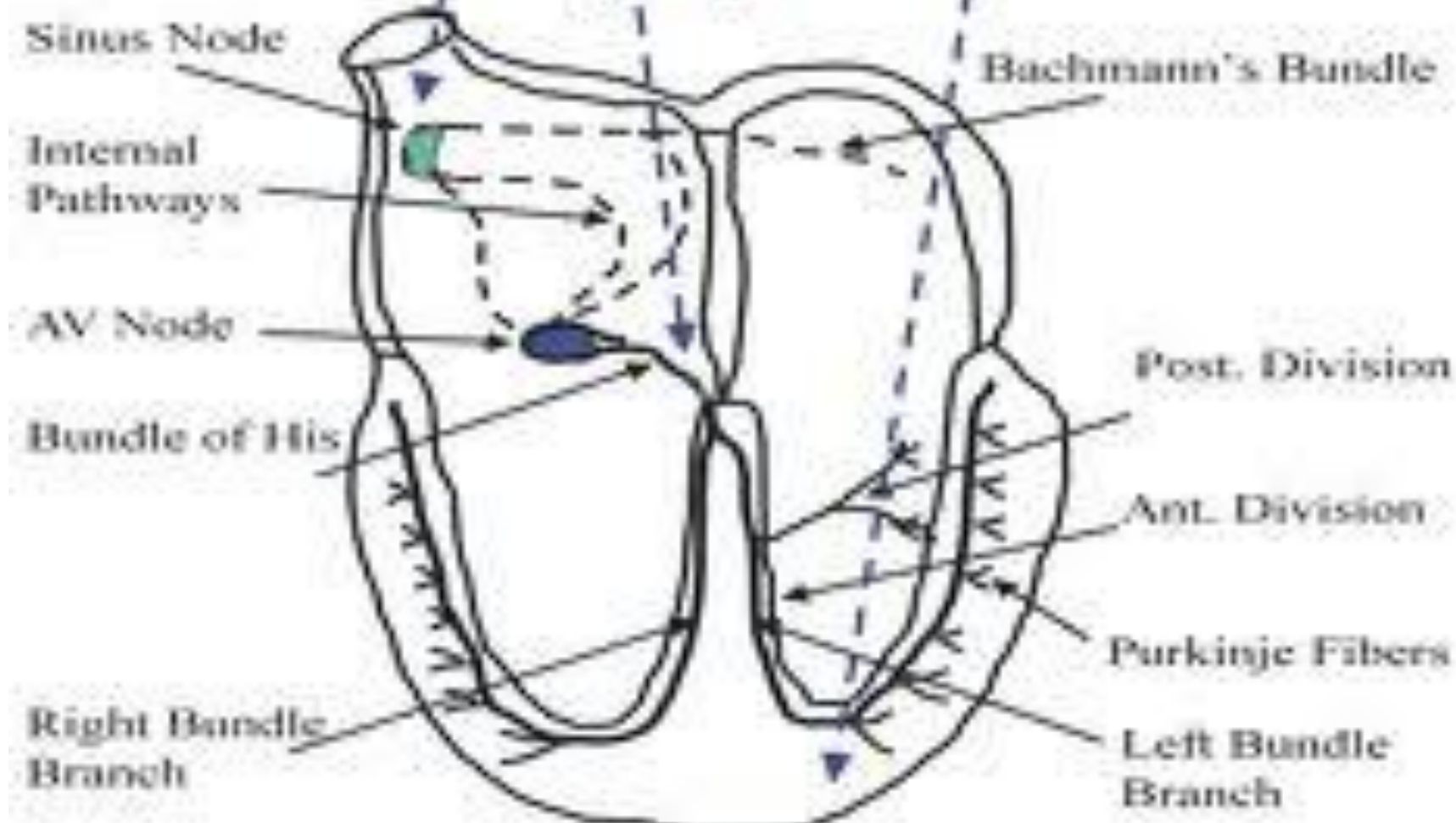
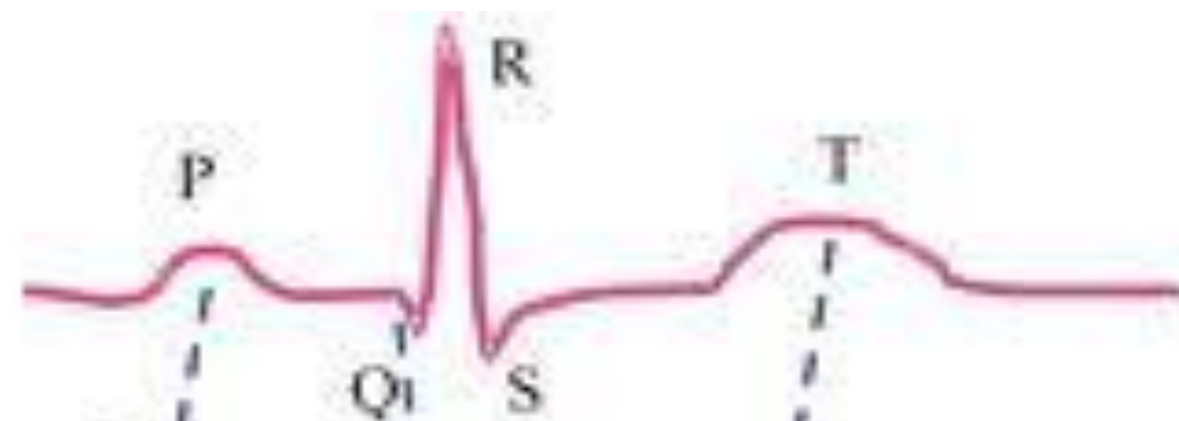
Cardiac Troponins (I & T)

Electrocardiography

- ECG is used to determine the cardiac rhythm and the condition of the conducting tissue.
- Information is also gained about chamber size and the presence of myocardial ischaemia and infarction , and about the effects of some drugs on the heart.

Electrocardiogram (ECG)





I II III

aVR aVL aVF

V1 V2 V3

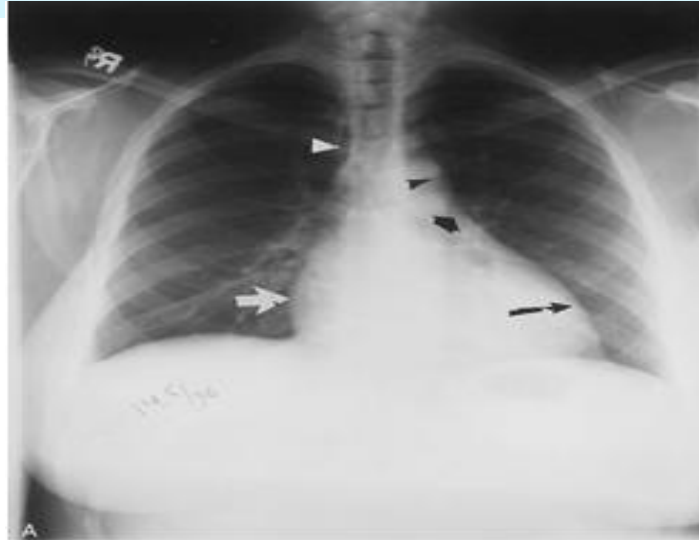
V4 V5 V6



Chest x-ray

- The normal heart occupies less than 50% of the transthoracic diameter in the frontal plane.
- On the patient's left, the cardiac silhouette is formed by the aortic arch, the pulmonary trunk, the LA appendage and LV.
- On the right, the RA is joined by superior and inferior cavae, and the lower right border is made up by the RV.

3. Chest X-Ray (Pa & Lat.) Normal



LVH



Dextrocardia

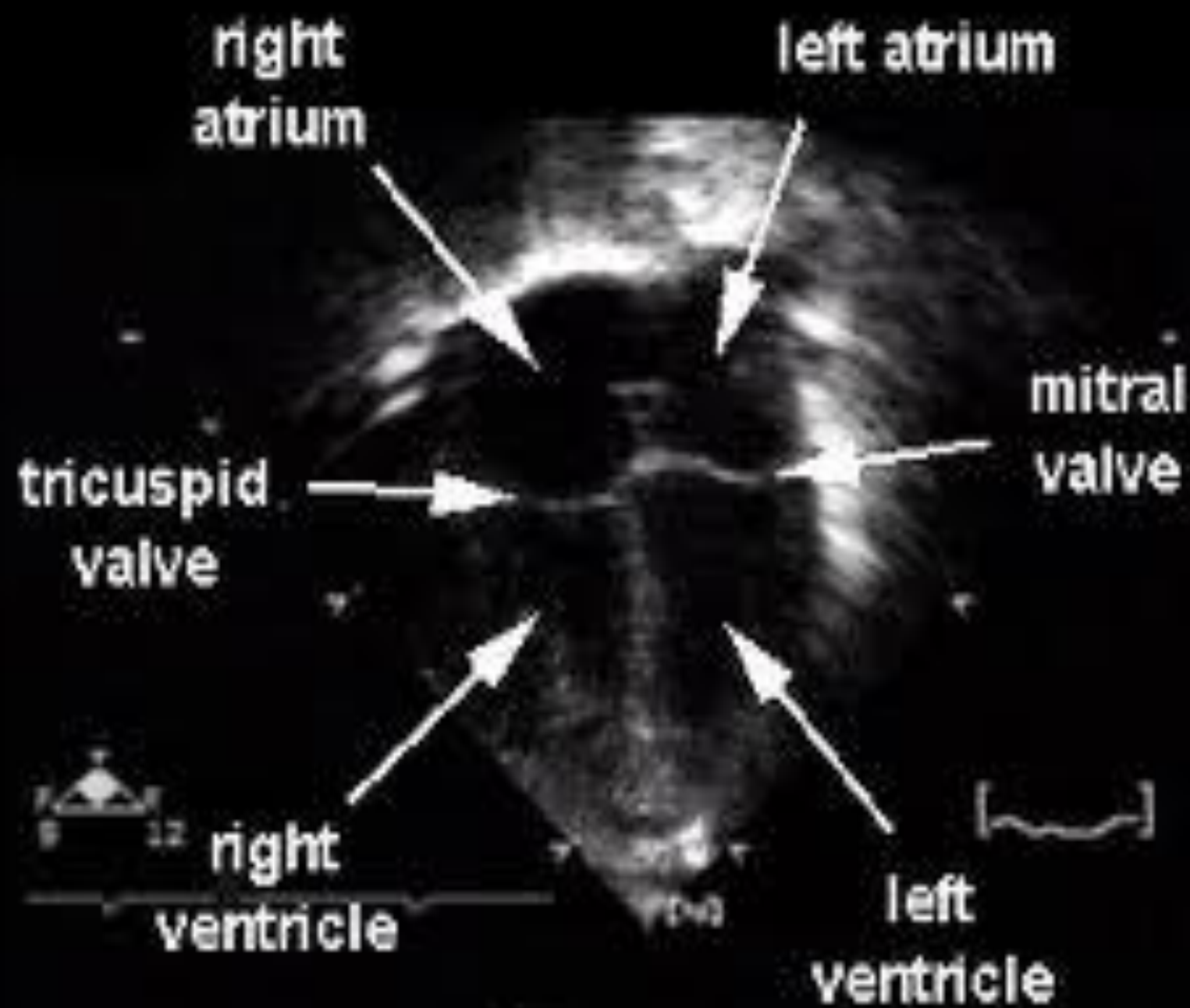


4.Echocardiography

- 2D Echo (chamber, valve, pericardium & great vessels)
- Doppler Echo (flow across valve & vessels) & coloured doppler (shunt)
- TEE (posterior structure of the heart (left atrium, mitral valve & aorta..Useful in dissecting aneurysm).
- * Stress Echo

Common indications for echocardiography

- Assessment of left ventricular function.
- Diagnosis and quantification of severity of valve disease.
- Identification of vegetations in endocarditis.
- Identification of structural heart disease in atrial fibrillation.
- Detection of pericardial effusion.
- Identification of structural heart disease in systemic embolism.





2 D Echo (ASD)



A



B

01/23/2004 01:28:25 PM



GDP 30 KG

GAIN 77

COMP 60

110BPM

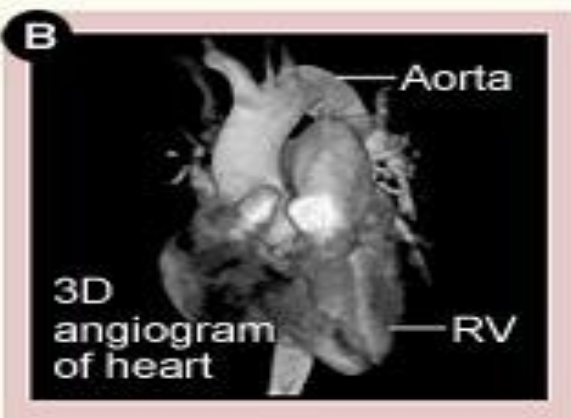
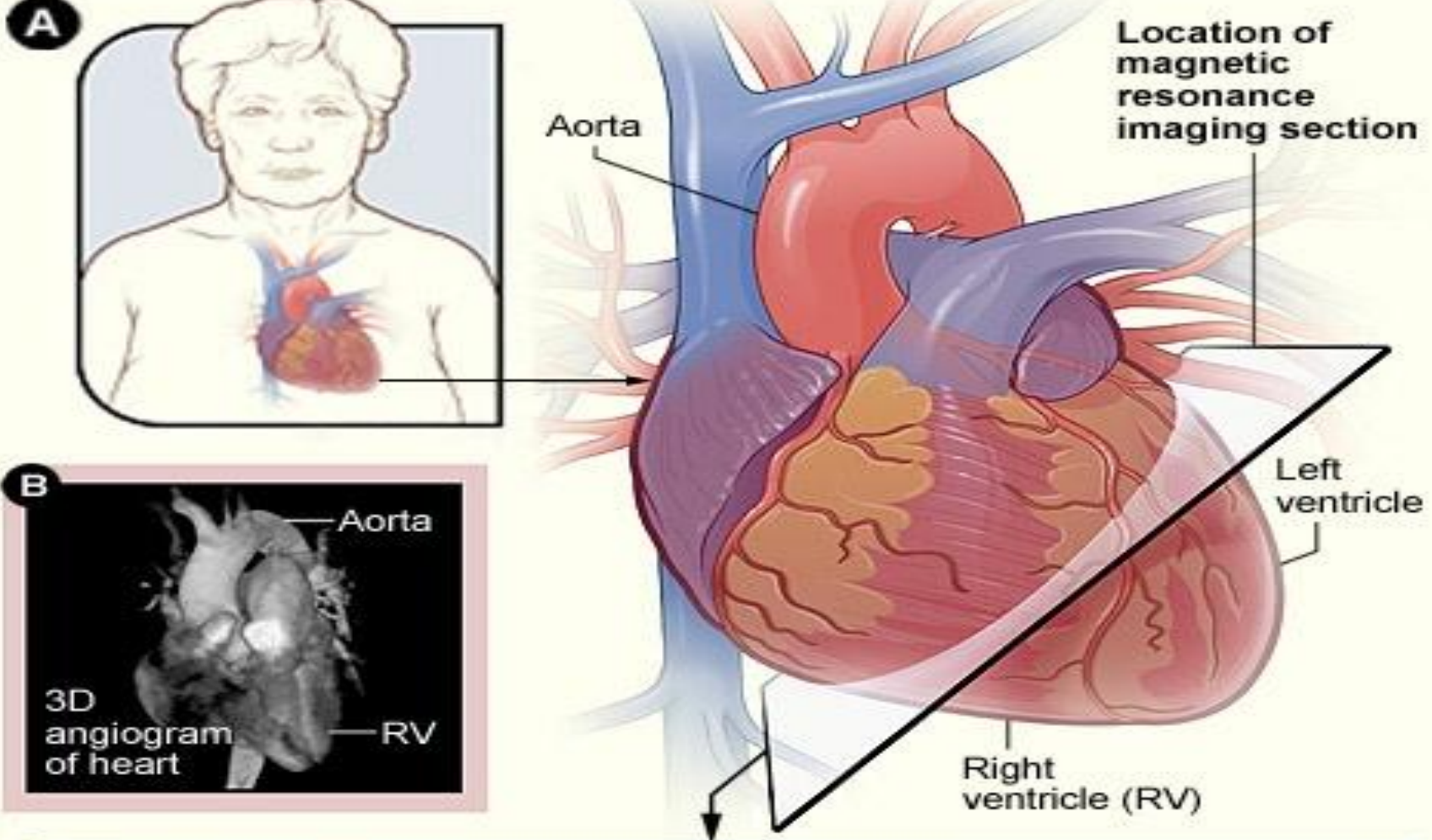
10CM

60HZ



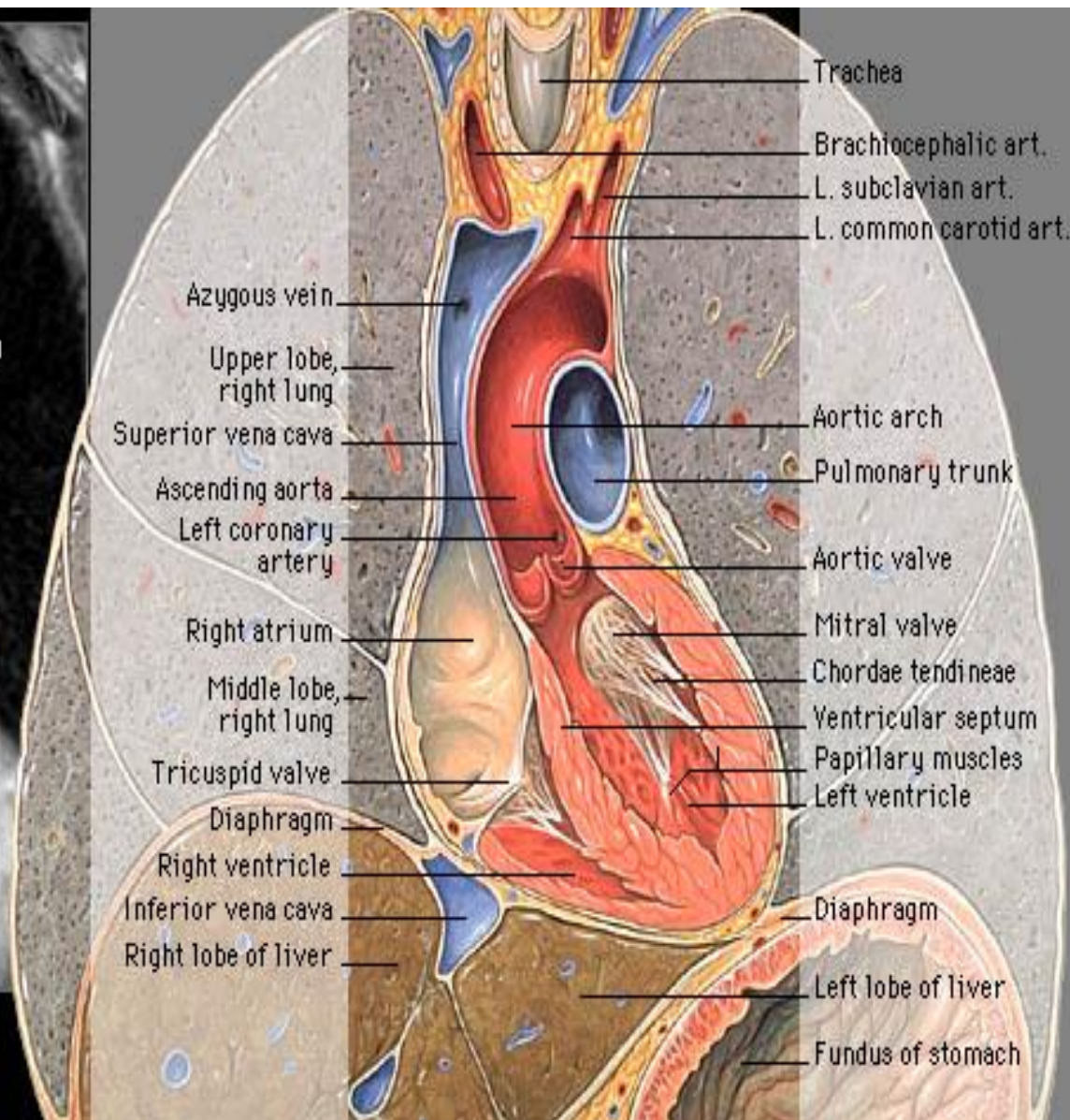
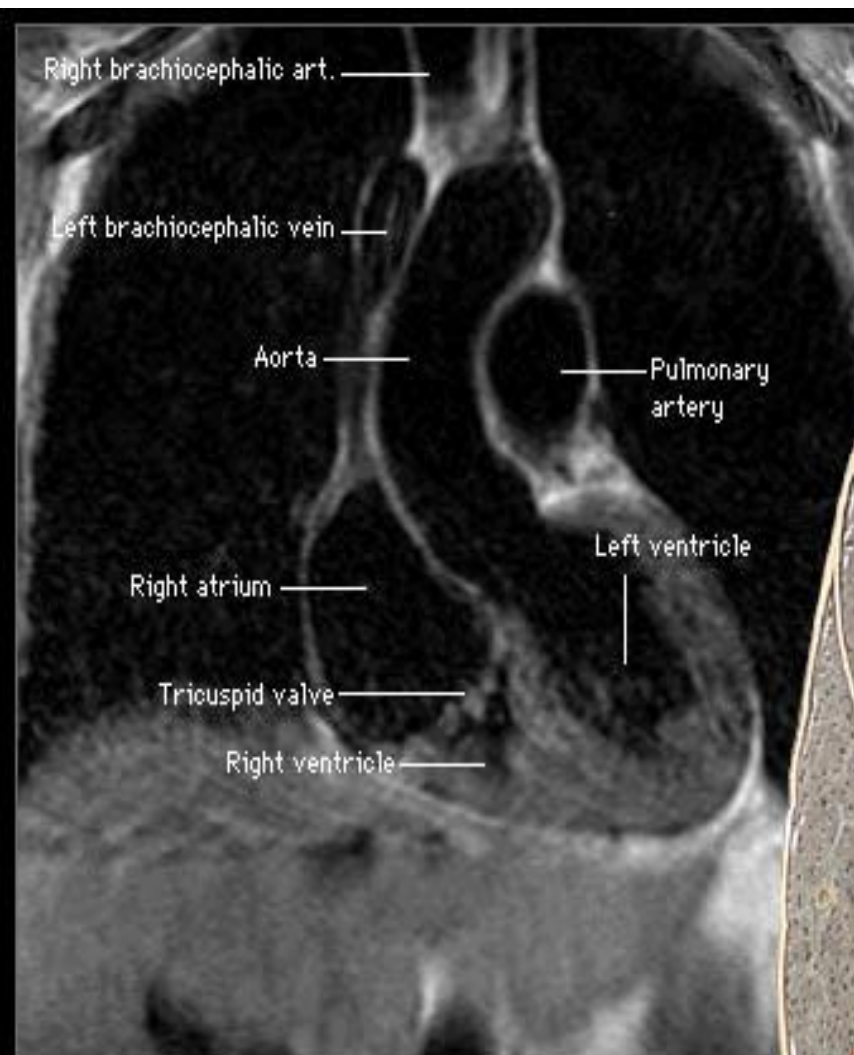
5.Cardiac CT & MRI

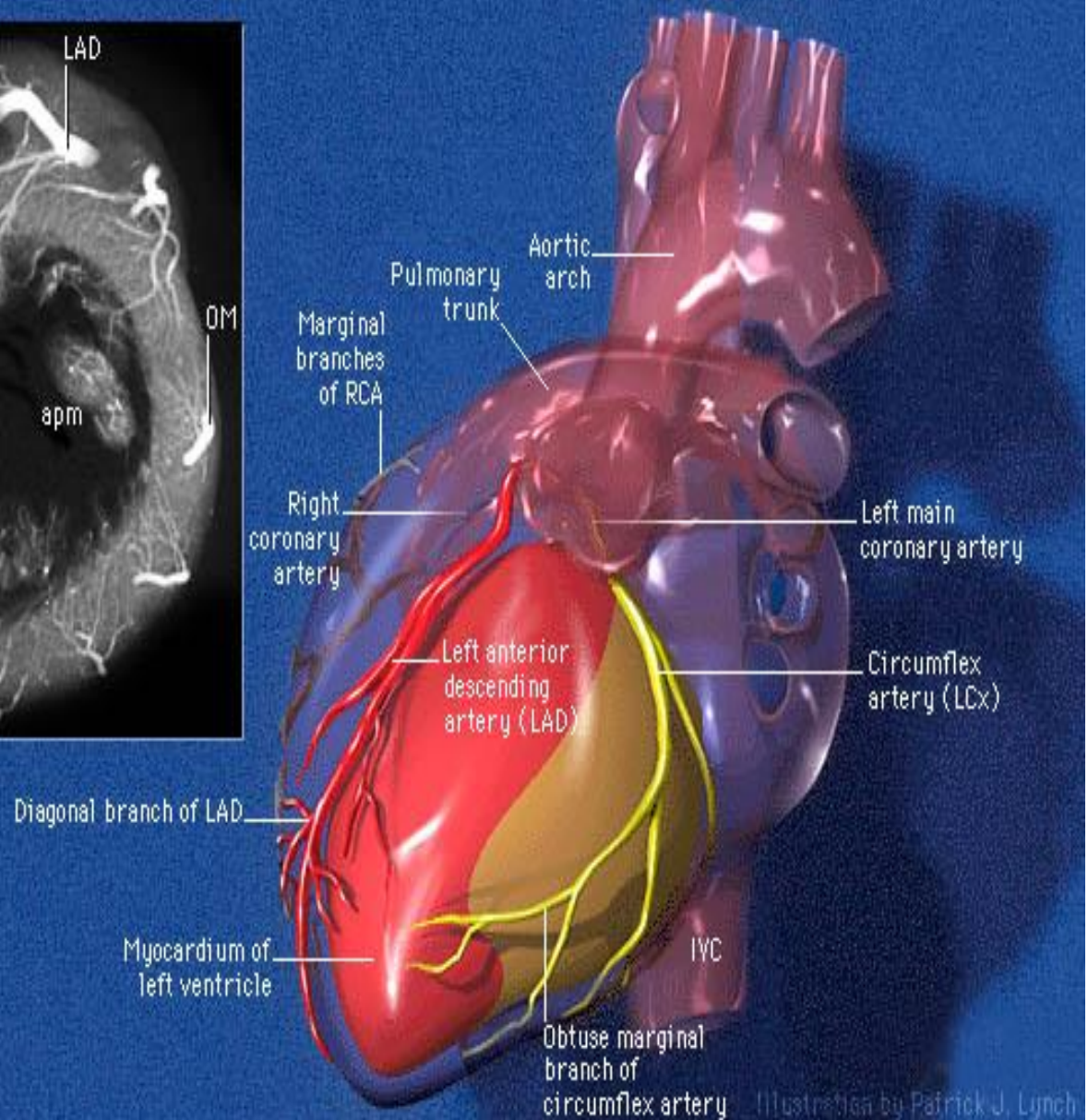
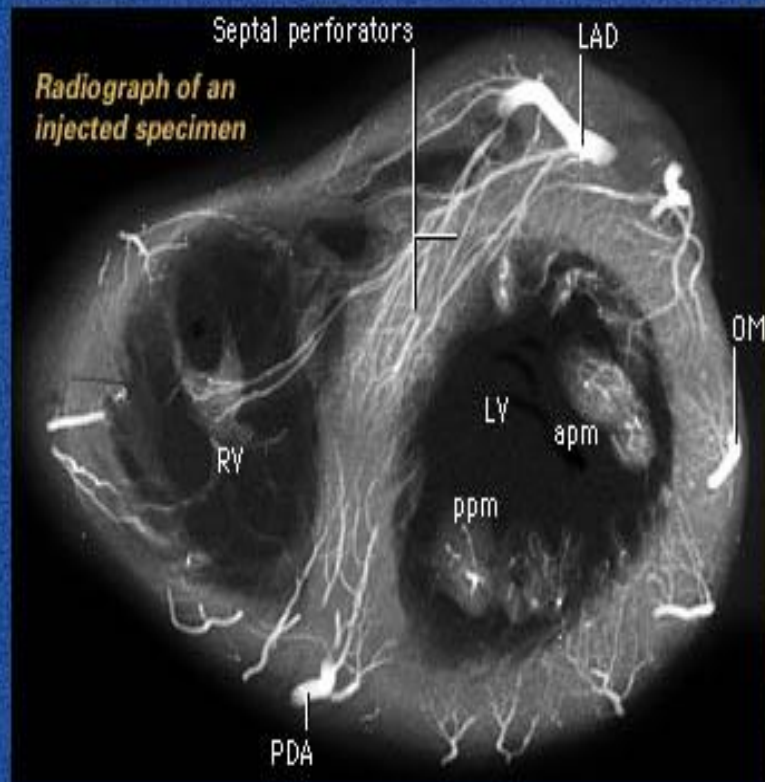
- **Useful in studying cardiac structure and function. Useful also in detecting masses
Studying the pericardium & great vessels.**
- **CT scan detection of coronary calcification**
- **MRI stress testing is useful in ventricular function & perfusion.**



6.CTA & MRA

- **Good for the study of blood vessels... helpful in CAD especially CA anomaly & pulmonary embolism & dissecting aneurysm...**
- **Multi-detector computed tomography (MDCT), New & promising, may replace angiography**

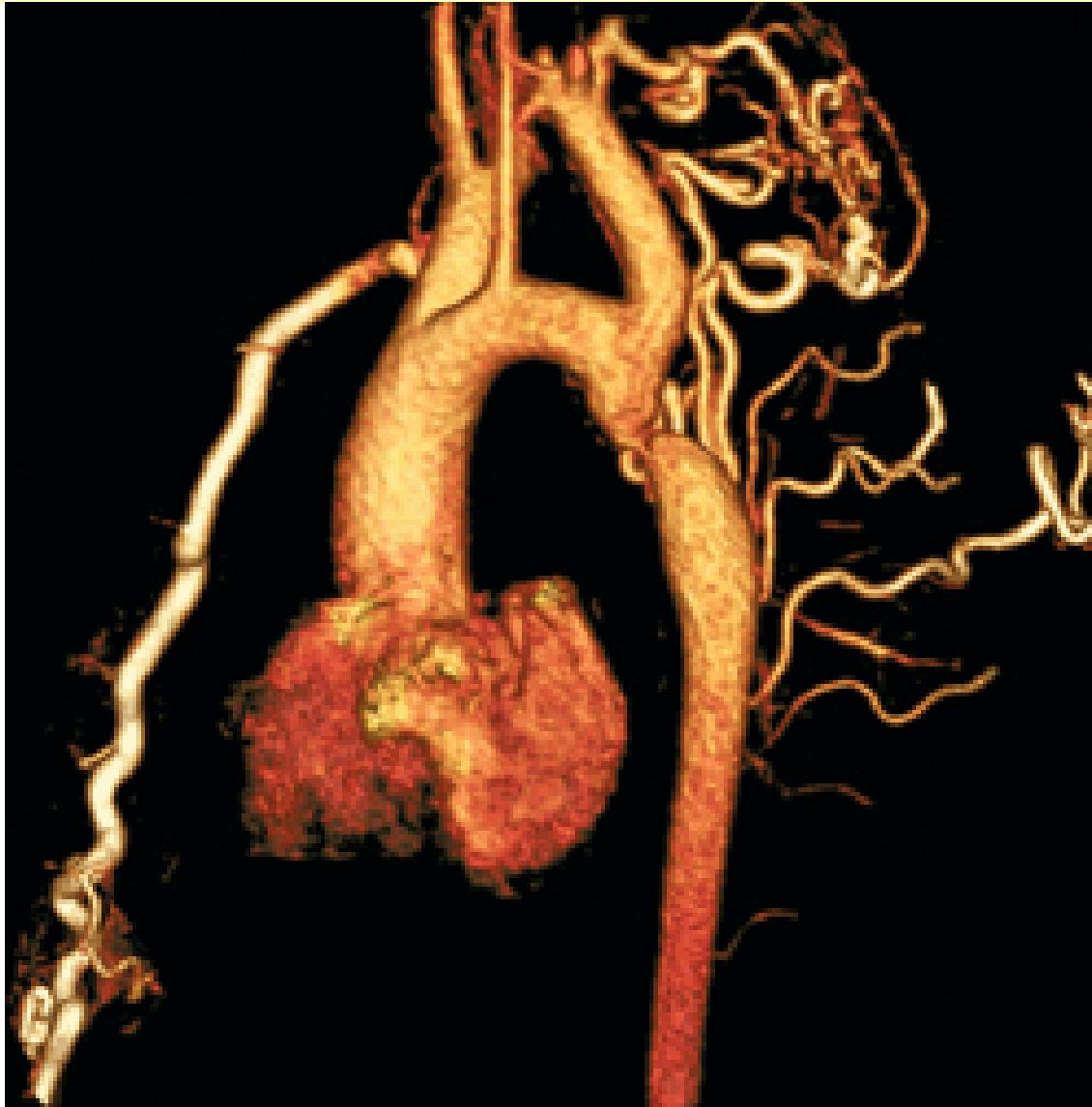


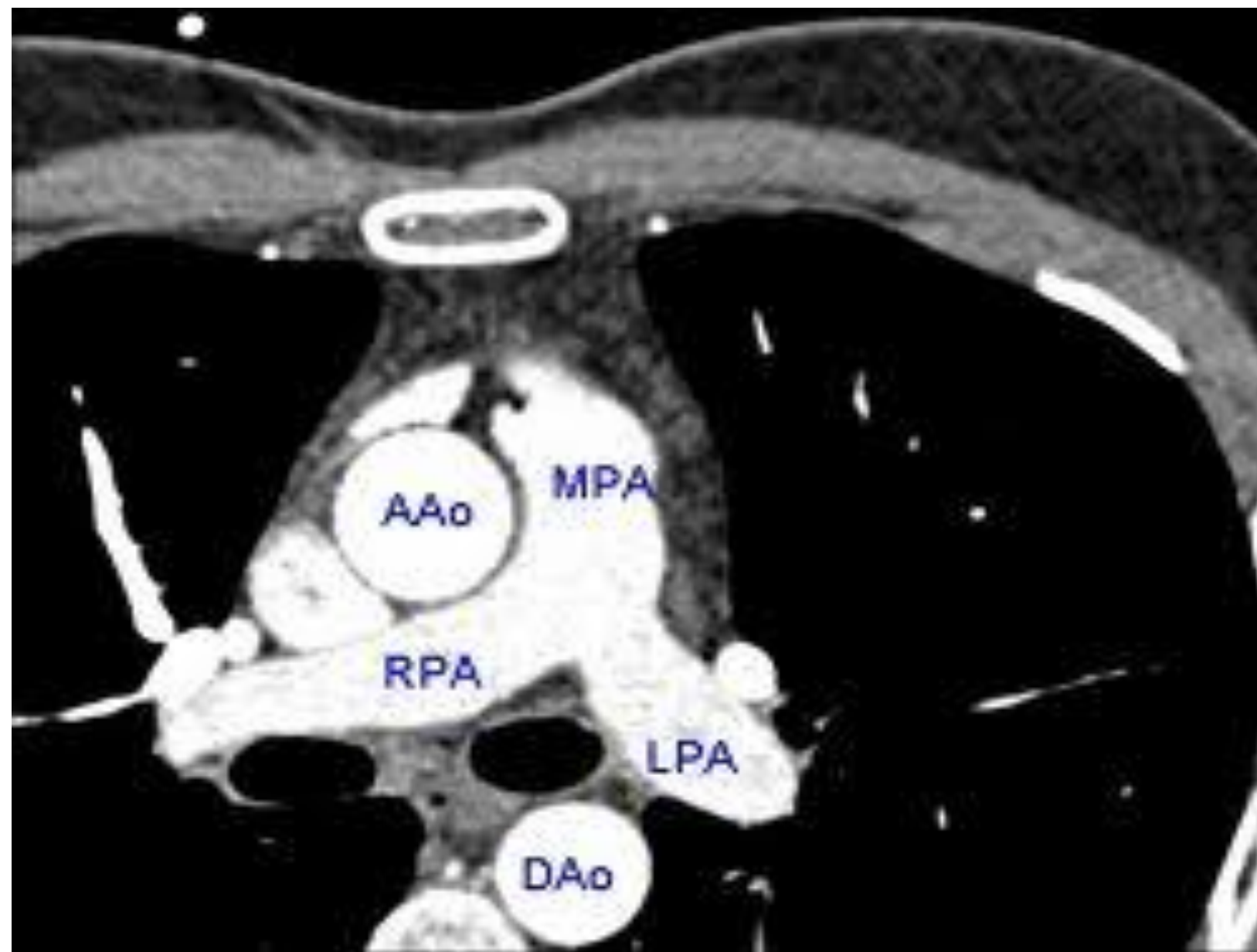


3D Model Animation

Illustration by Patrick J. Lynch

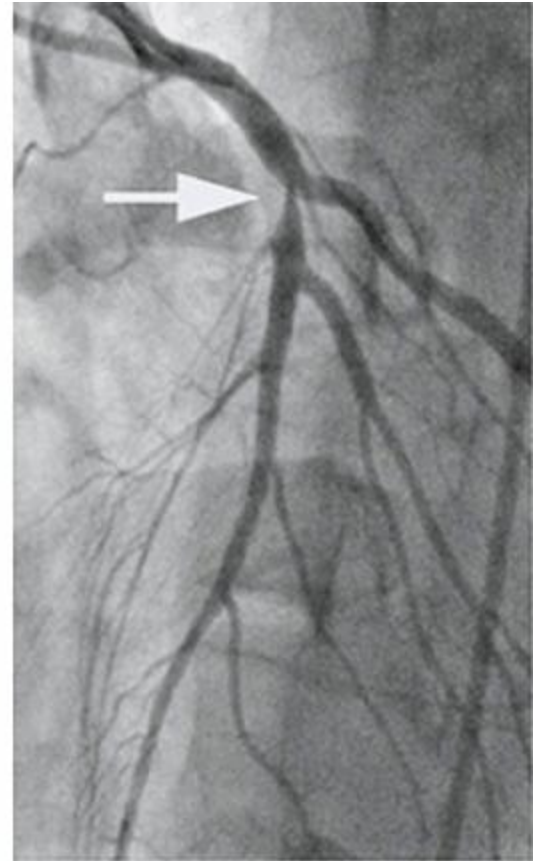
MRA of the aorta (Coaractation)







Multidetector CT compared to angiography

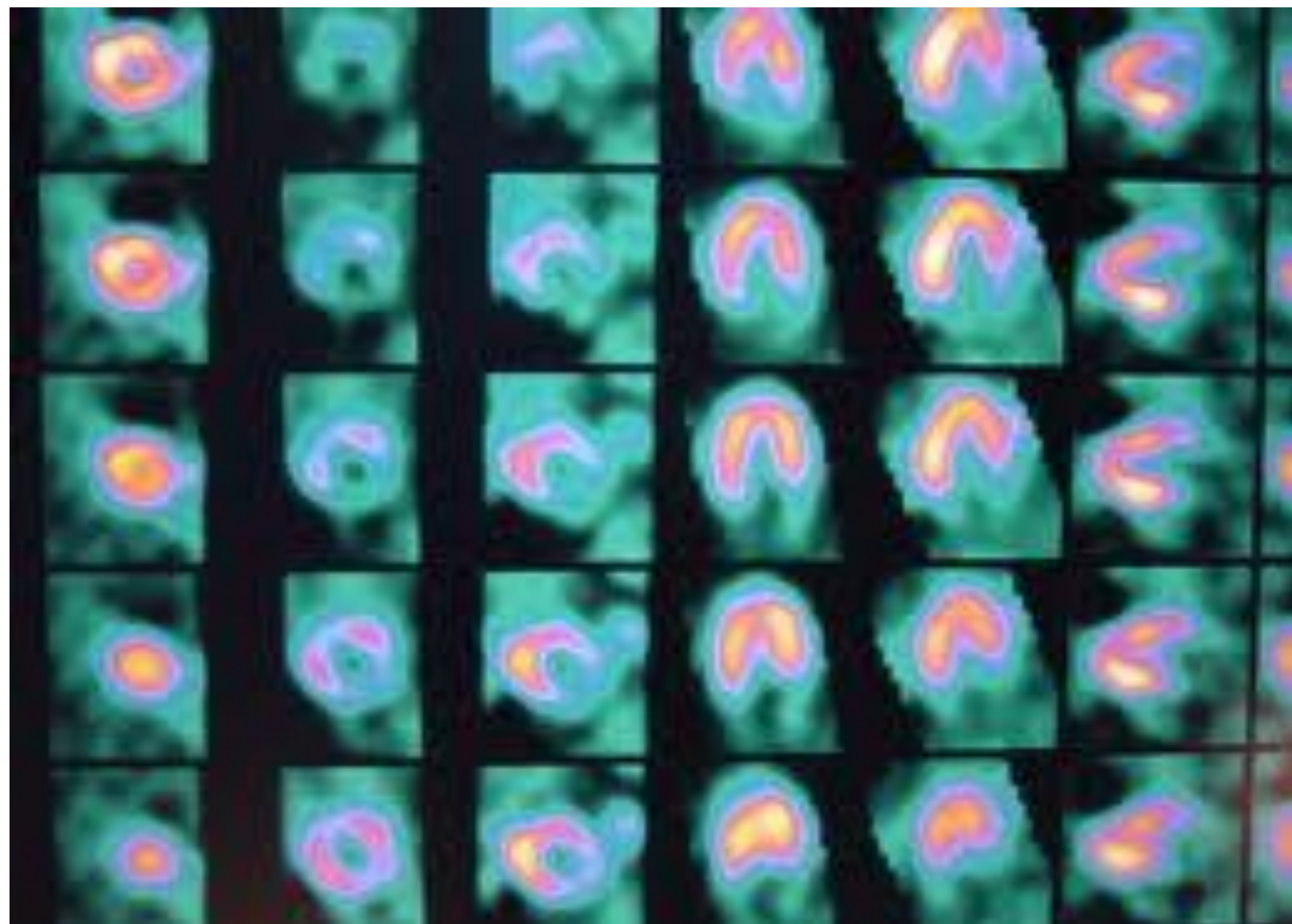




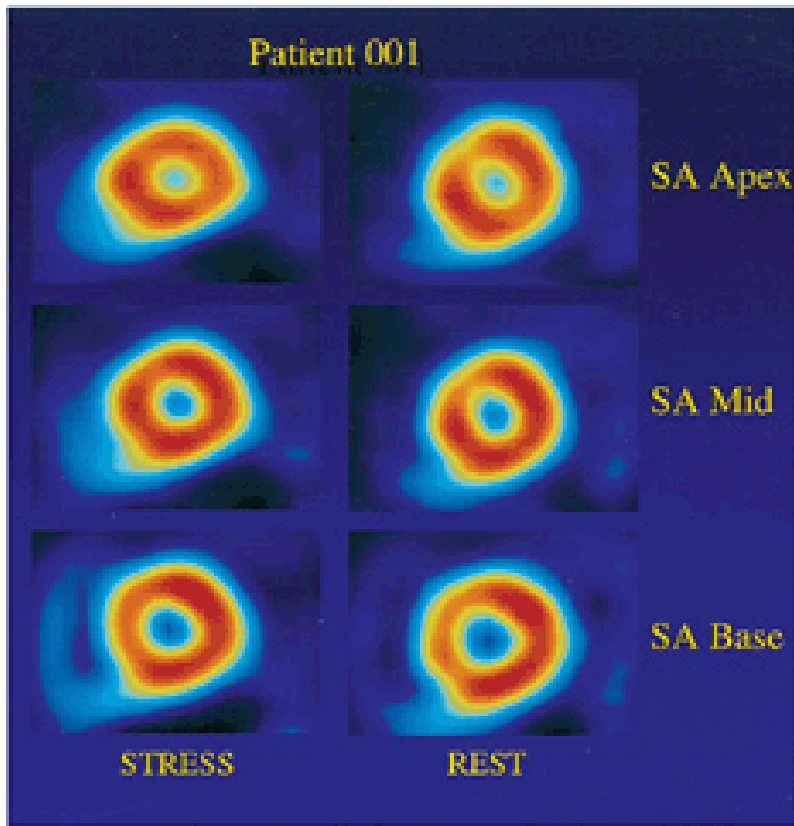


7.Nuclear Cardiology

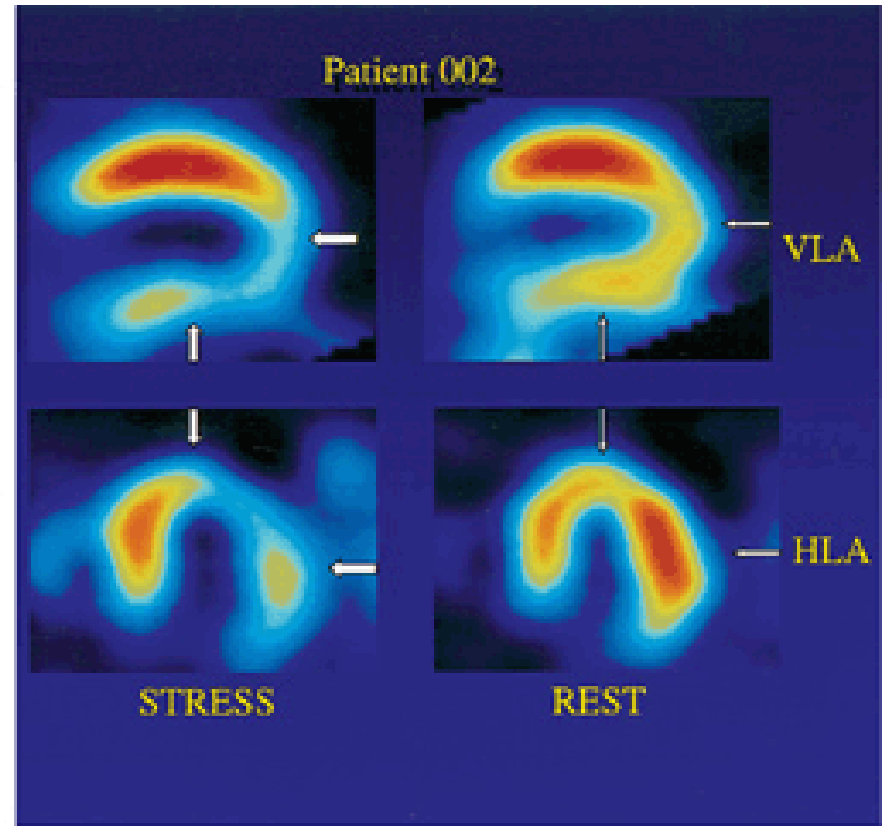
- Useful for assessment of **myocardial perfusion and ventricular function.**
- **Isotopes used are Tc-99 or Thallium-201**
- **(SPECT)- single photon emission computed tomography) & (PET)- positron emission tomography**



Cardiac Imaging at rest & exercise



A

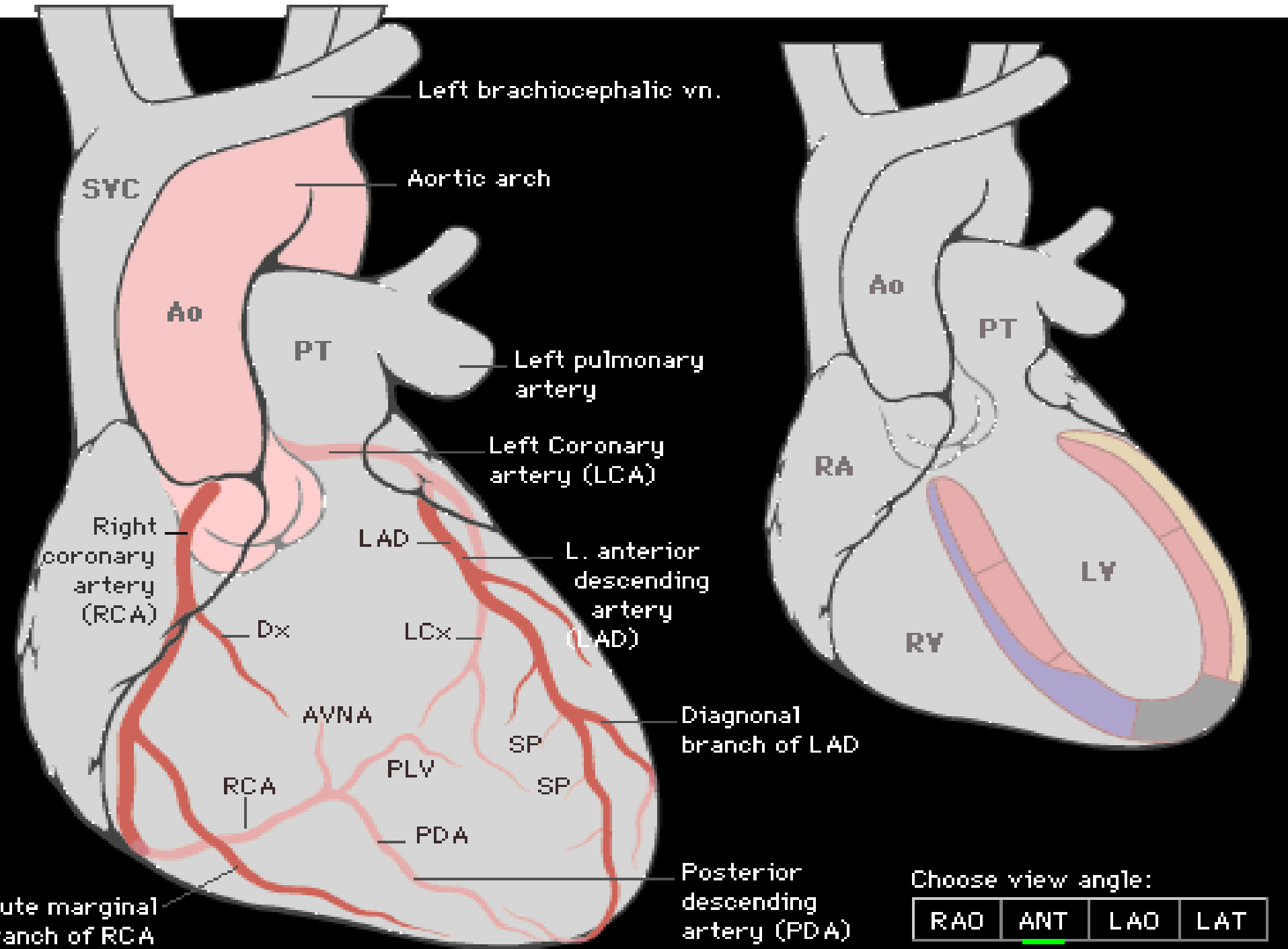


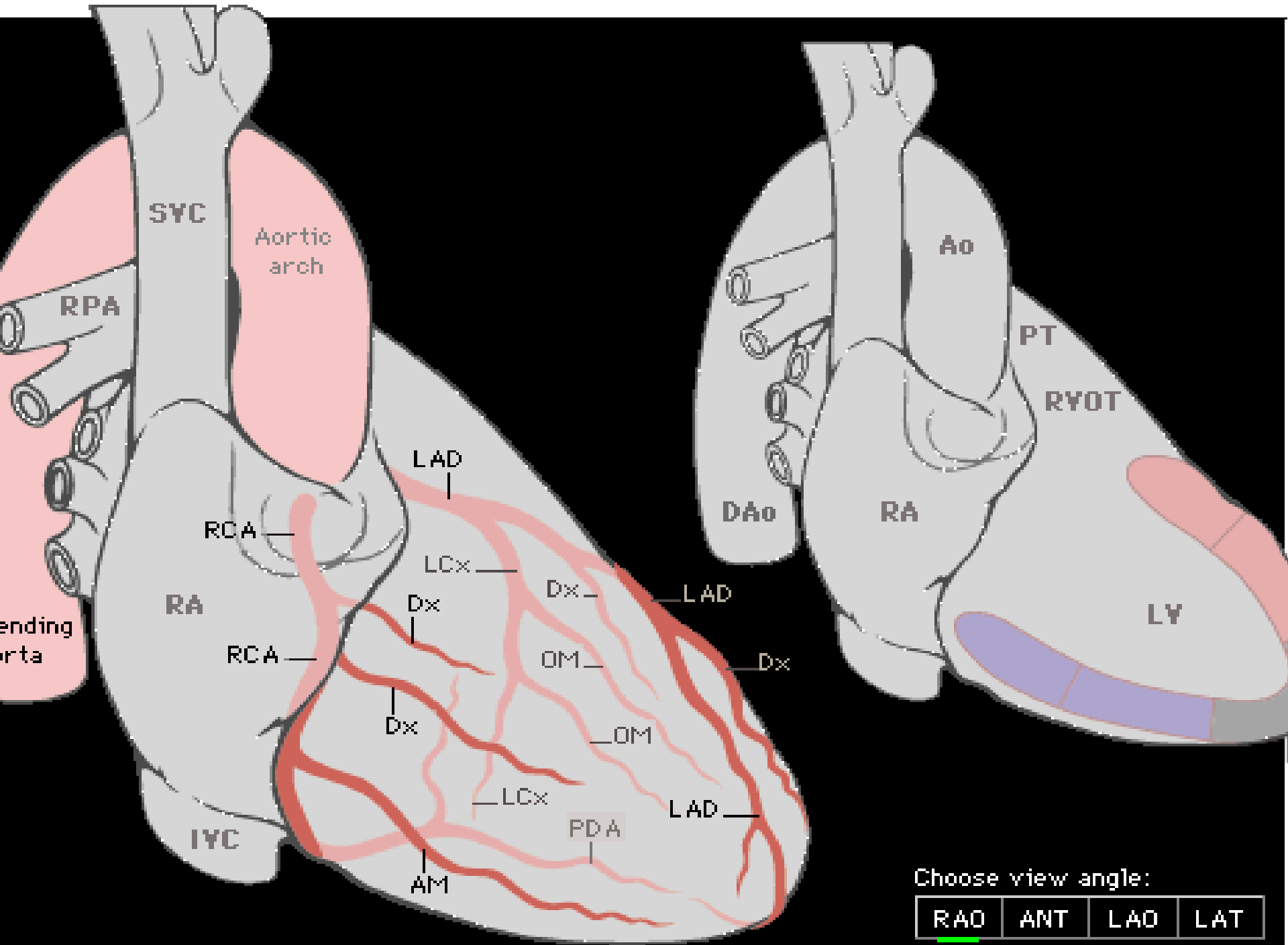
B

8.Cardiac Catheterization & Angiography

- **Right sided: Femoral vein > IVC > R.A.> RV > PA > PCW... (other alternative is Brachial vein > SVC**
- **Left sided : Peripheral artery > aorta > Left Ventricle.**

Measurement of pressure, O2 sat. & flow





Ventricular Angiography

Look for:-

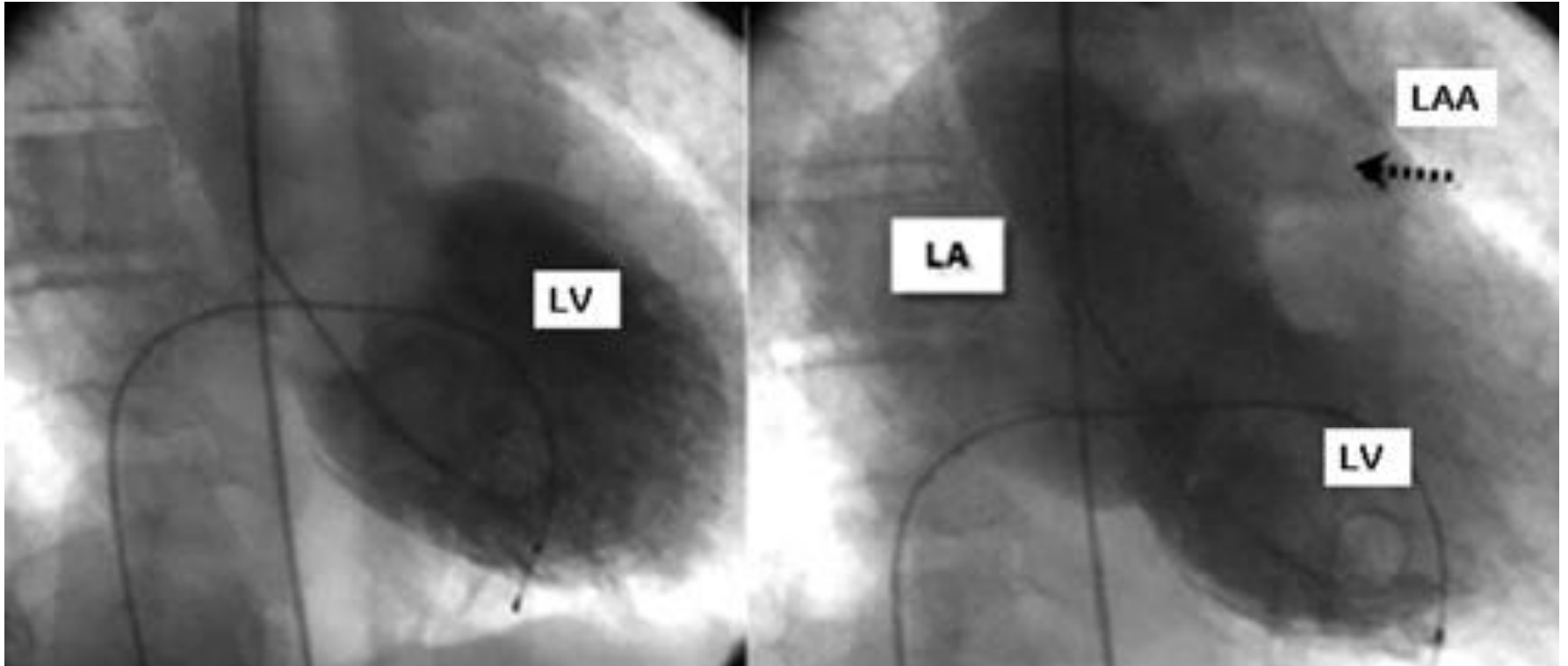
Contractility

Wall motion

Regurgitation of the dye retrogradely

Aortogram

LV Angiography (M.R.)



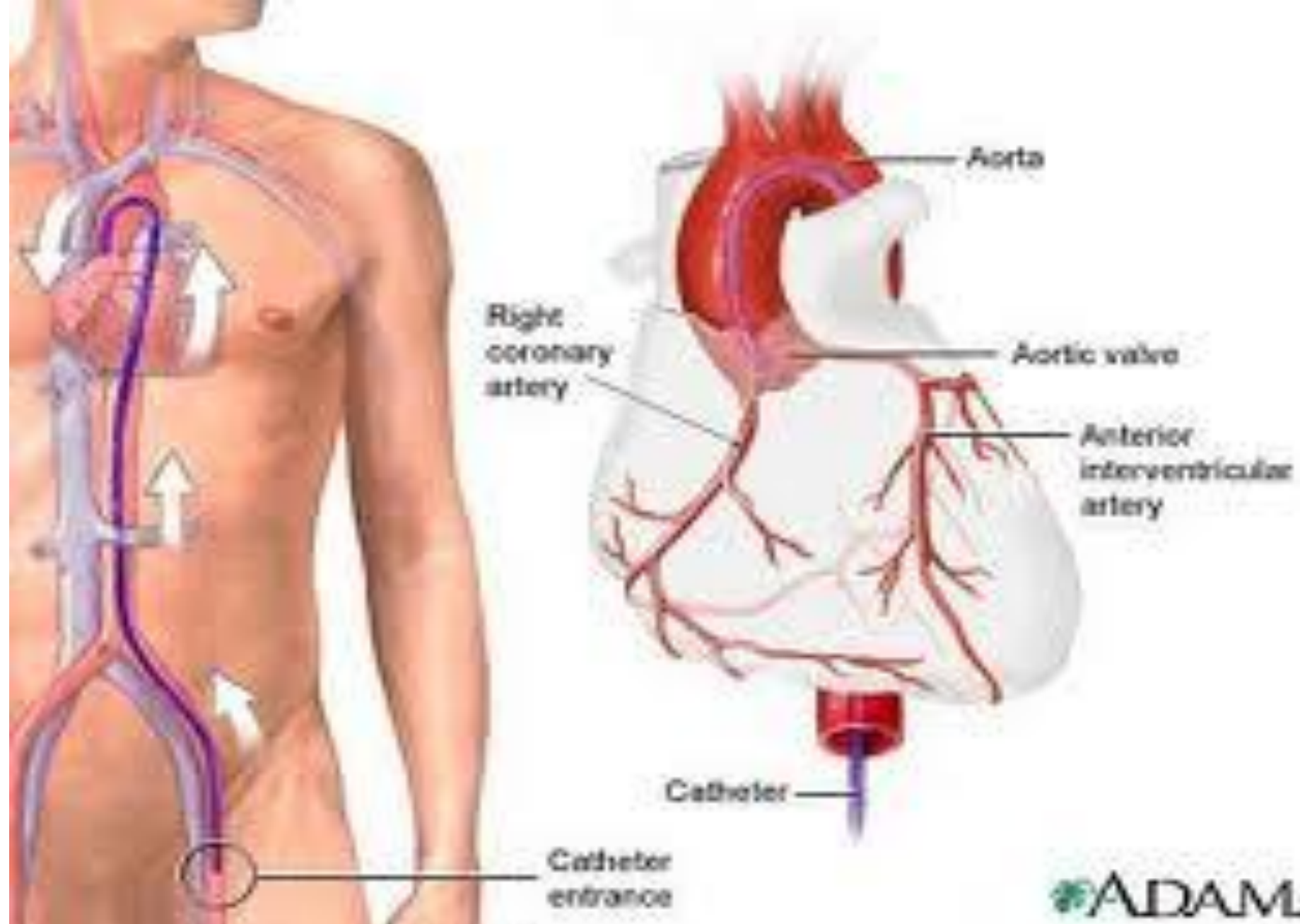
Selective Coronary Angiography

- **Standard technique to diagnose CAD**
- **Overall mortality 0.01%**
- **Major complication 0.1%**
- **Minor complications 1%**





SCIENCEPHOTOLIBRARY



Catheter
from groin
to heart

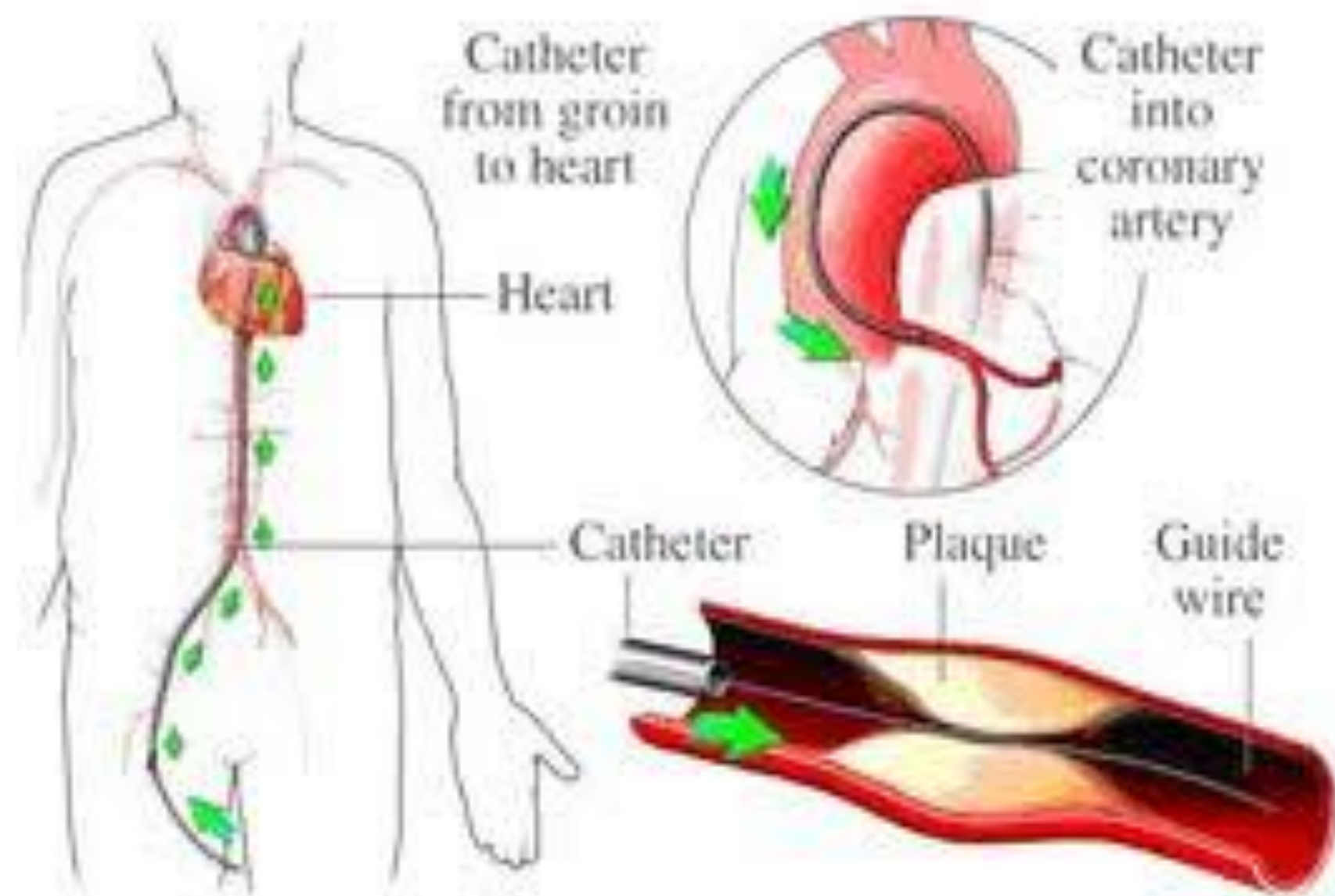
Heart

Catheter

Catheter
into
coronary
artery

Plaque

Guide
wire



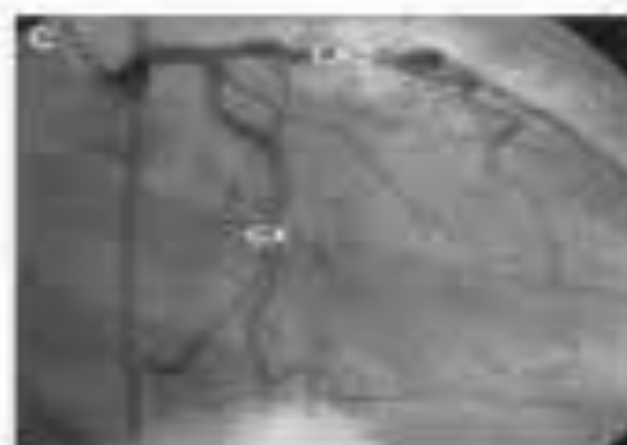
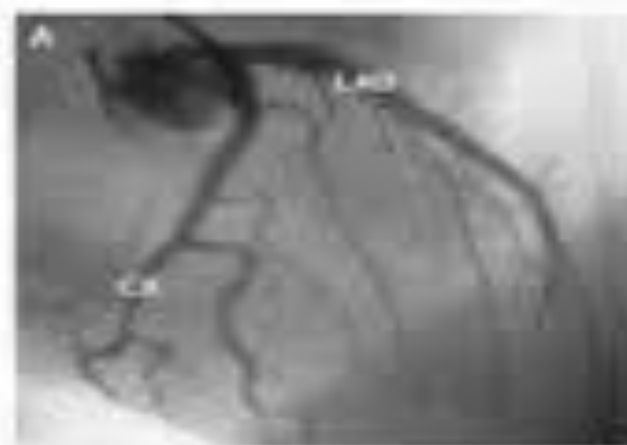
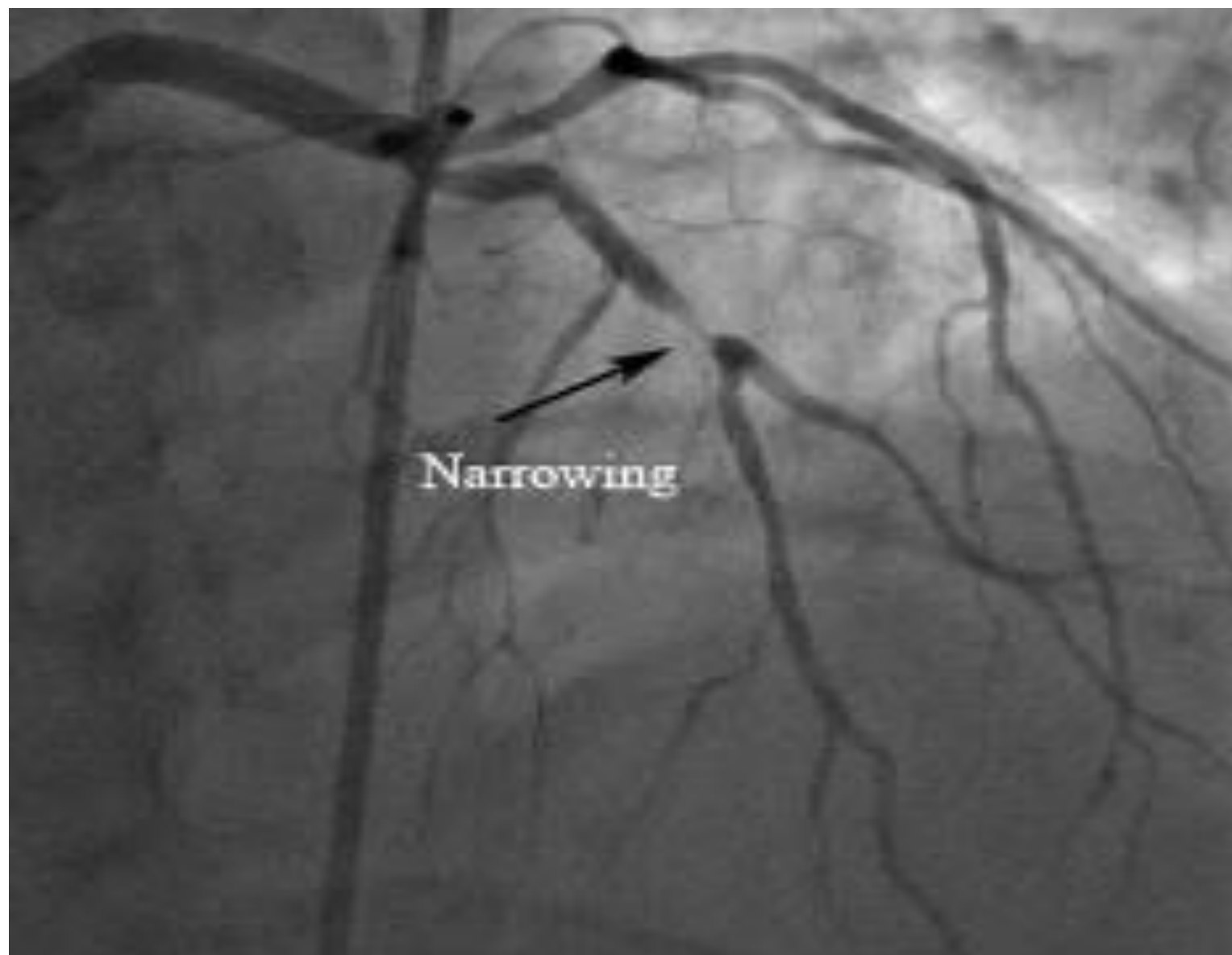
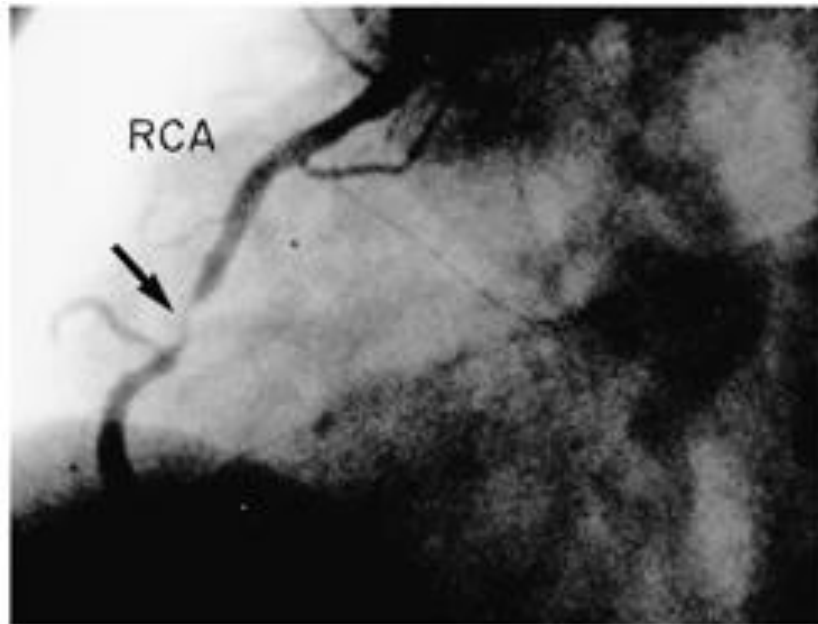


Figure 1 - Porcine and human epicardial coronary anatomy. Porcine (A and B). A, Left coronary system. B, Right coronary artery. Human (C and D). C, Left coronary system. D, Right coronary artery. Coronary angiography was undertaken via the right femoral approach in both pig and human. Similar anatomy and coronary distribution is shown of the left anterior descending, left circumflex, and right coronary arteries⁴⁰.

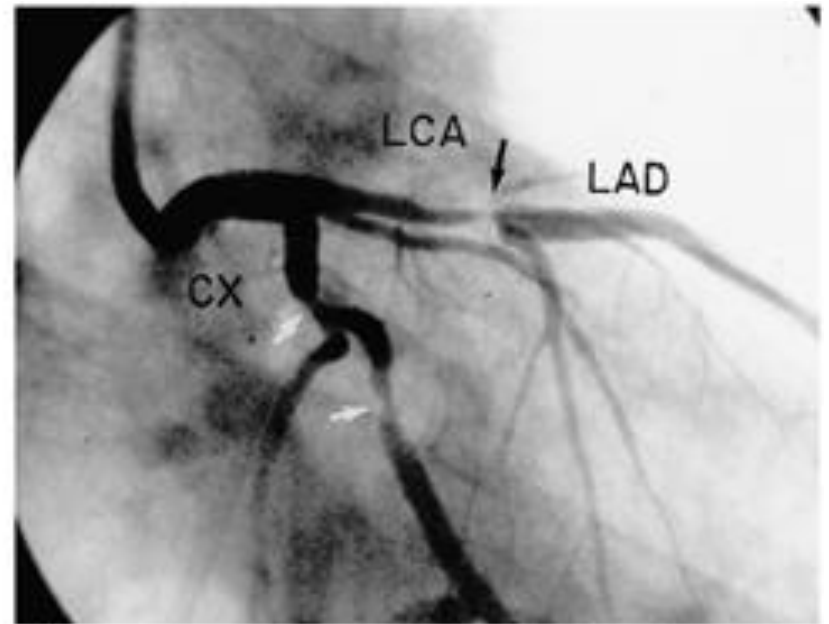


Narrowing

Diseased Coronary arteries



A



B

