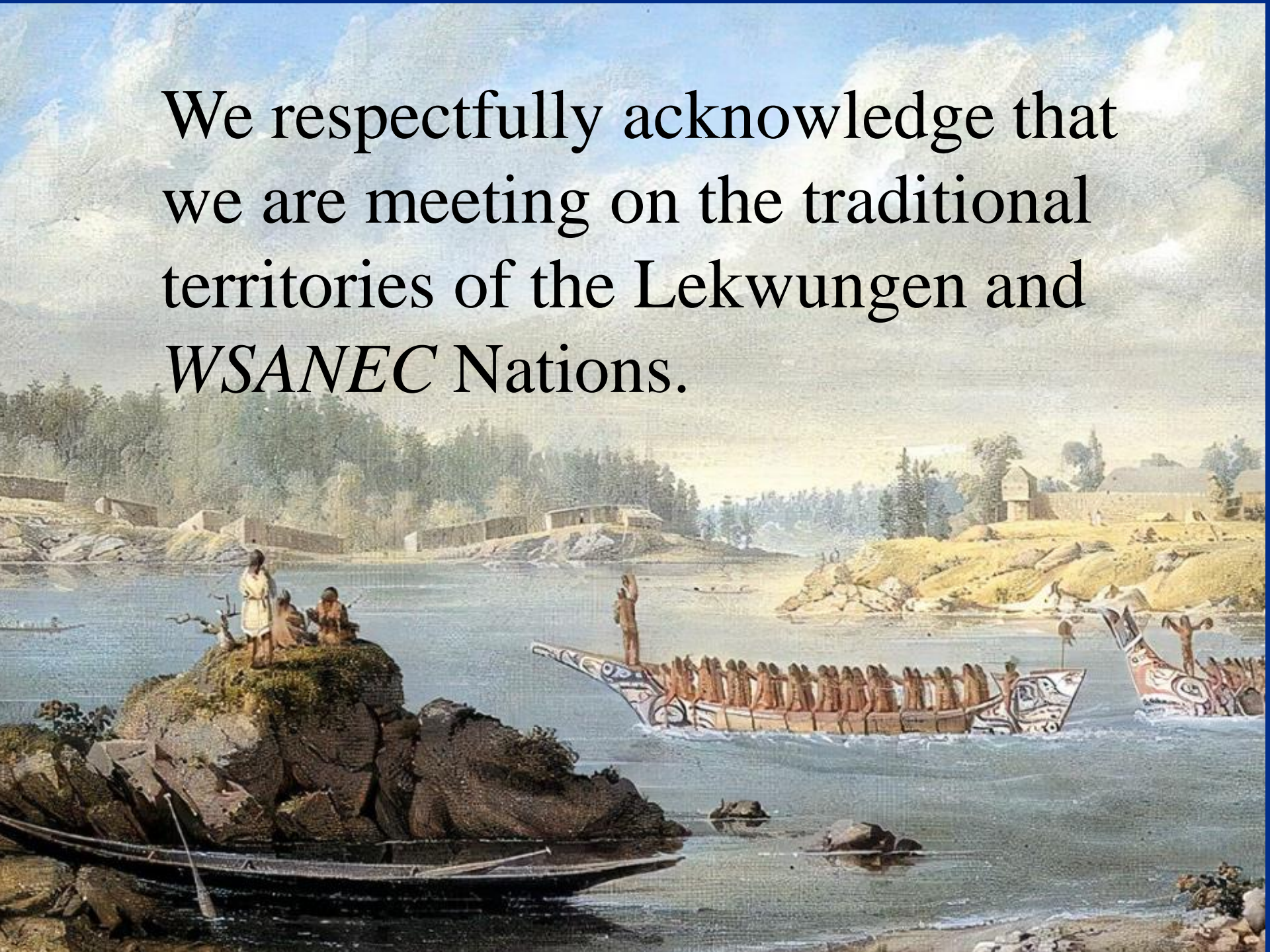


# The Body Works?

*Part of the UVic Retirees  
Association Elder Academy  
Program*

*Presenters: David Docherty, Ph.D.,  
Professor Emeritus, School of EPHE, UVic  
Chris Pengilly, M.D.  
Retired Family Physician*

We respectfully acknowledge that we are meeting on the traditional territories of the Lekwungen and *WSANEC* Nations.



# Overall approach:

1. Purpose: To provide some insight into how the body works and what can go wrong so you are able to understand what goes on in your body and communicate more effectively with medical professionals.

# Presentations: two parts

1. The anatomy and function of **four** selected systems
2. Things that can go wrong and the **medical interventions** commonly available

# 4 Systems:

- The Heart (March 5th)
- The Articulations, in particular the knee and hip joints (March 12<sup>th</sup>)
- The Brain (March 19<sup>th</sup>)
- The Immune System (March 26<sup>th</sup>)

- Anatomy and function of the heart
- Medical interventions



"I thought for a minute I'd lost you there but I guess the old stetho's on the blink."

# Anatomy and function

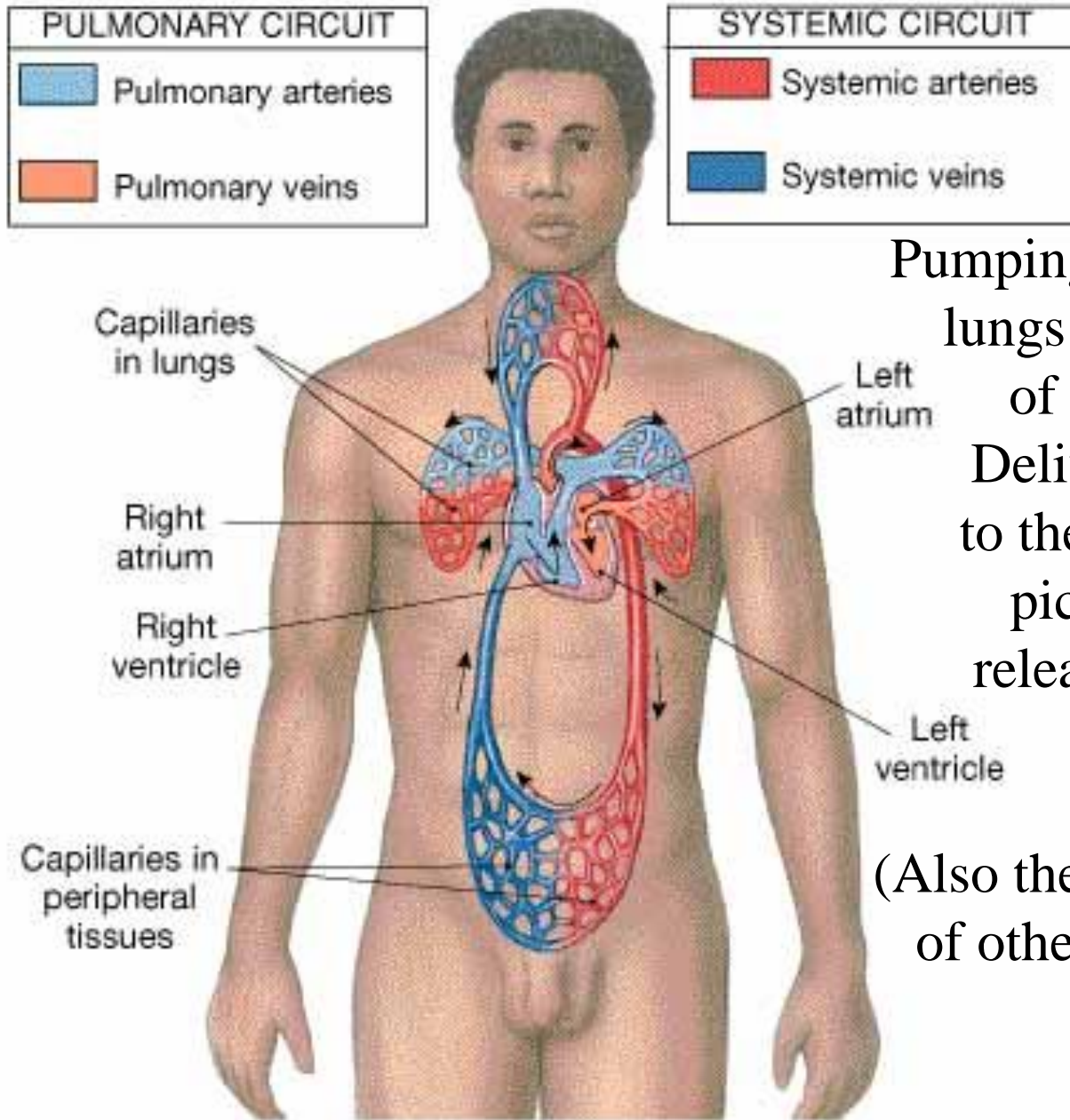
An anatomical illustration of the human heart and lungs, showing the complex network of blood vessels and the structure of the heart muscle. The heart is centrally located, with the lungs on either side. The illustration is detailed, showing the branching of the bronchi and the intricate network of arteries and veins.

- **Overall function of the heart**
- **Unique aspects of heart muscle**
- **Blood flow through the heart and function of the valves**
- **Blood supply to the heart**
- **Nerve conduction through the heart**
- **Central control of the heart**

Most slides are from Human Anatomy, 6th edition

Prentice Hall, © 2007

Figure 21-01: Pulmonary and systemic circuits

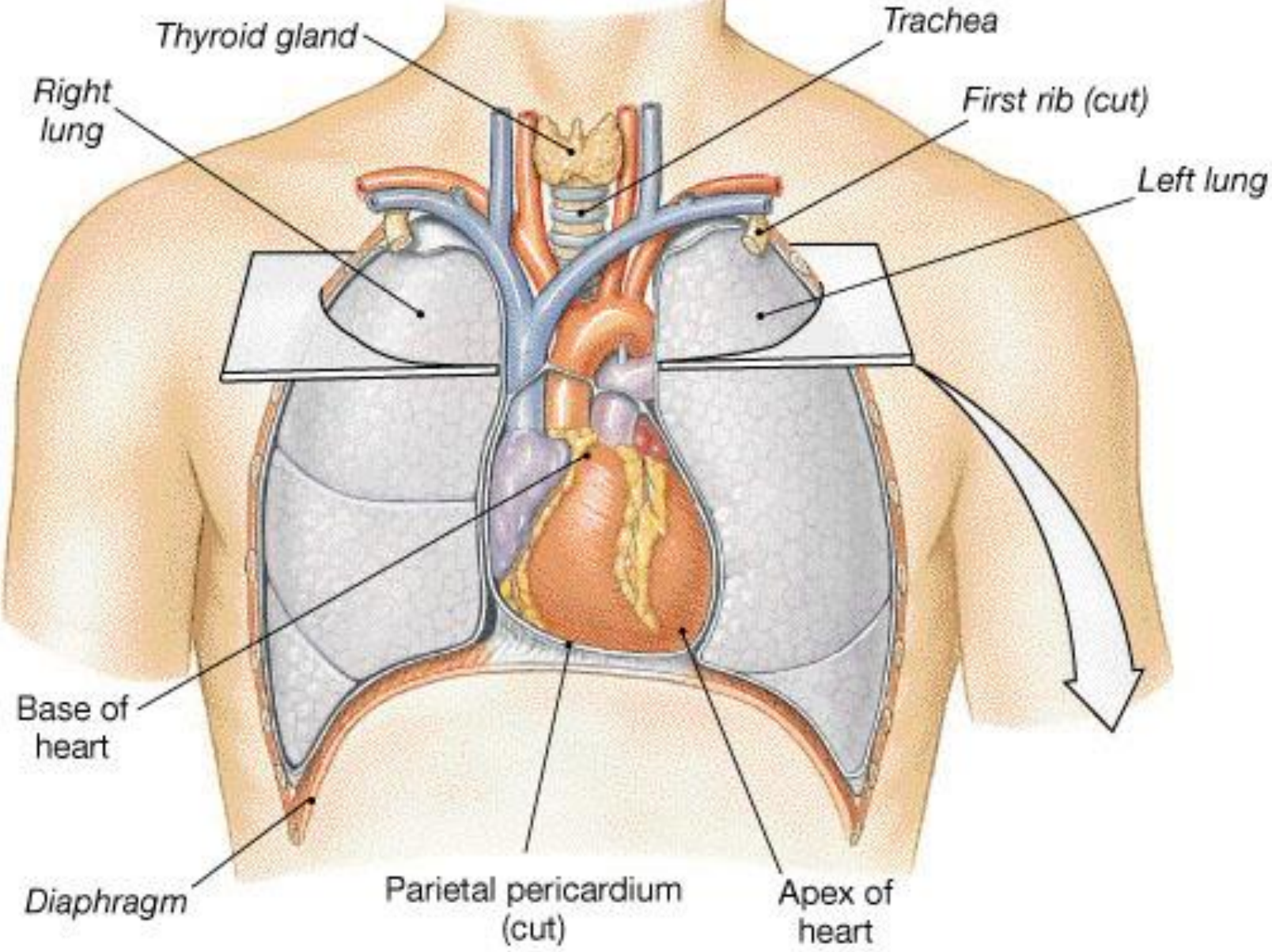


Pumping blood to the lungs and the rest of the body. Delivery of  $O_2$  to the body and pick up and release of  $CO_2$ .

(Also the transportation of other substances)

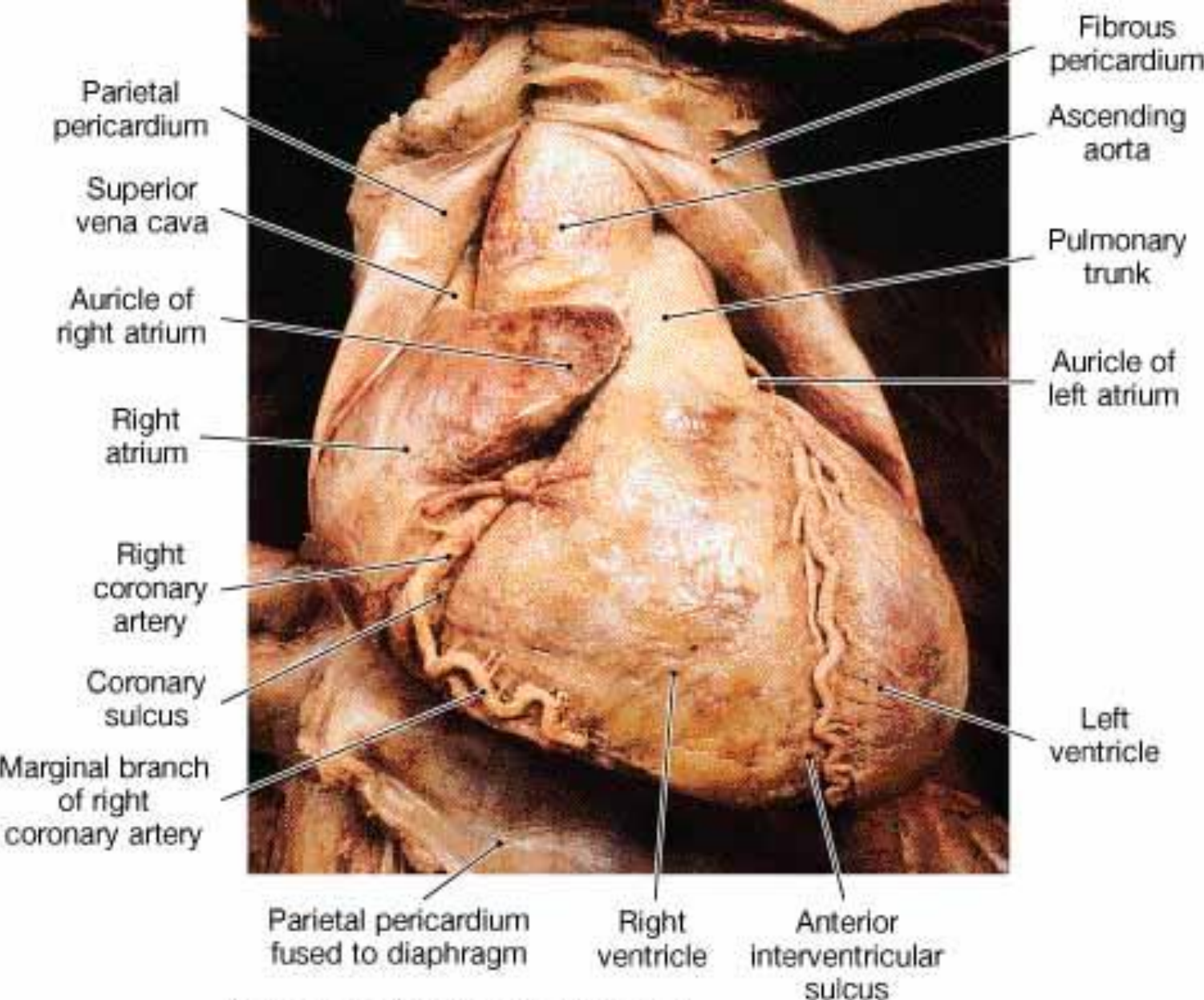


Figure 21-02a: Location of the heart (anterior view)



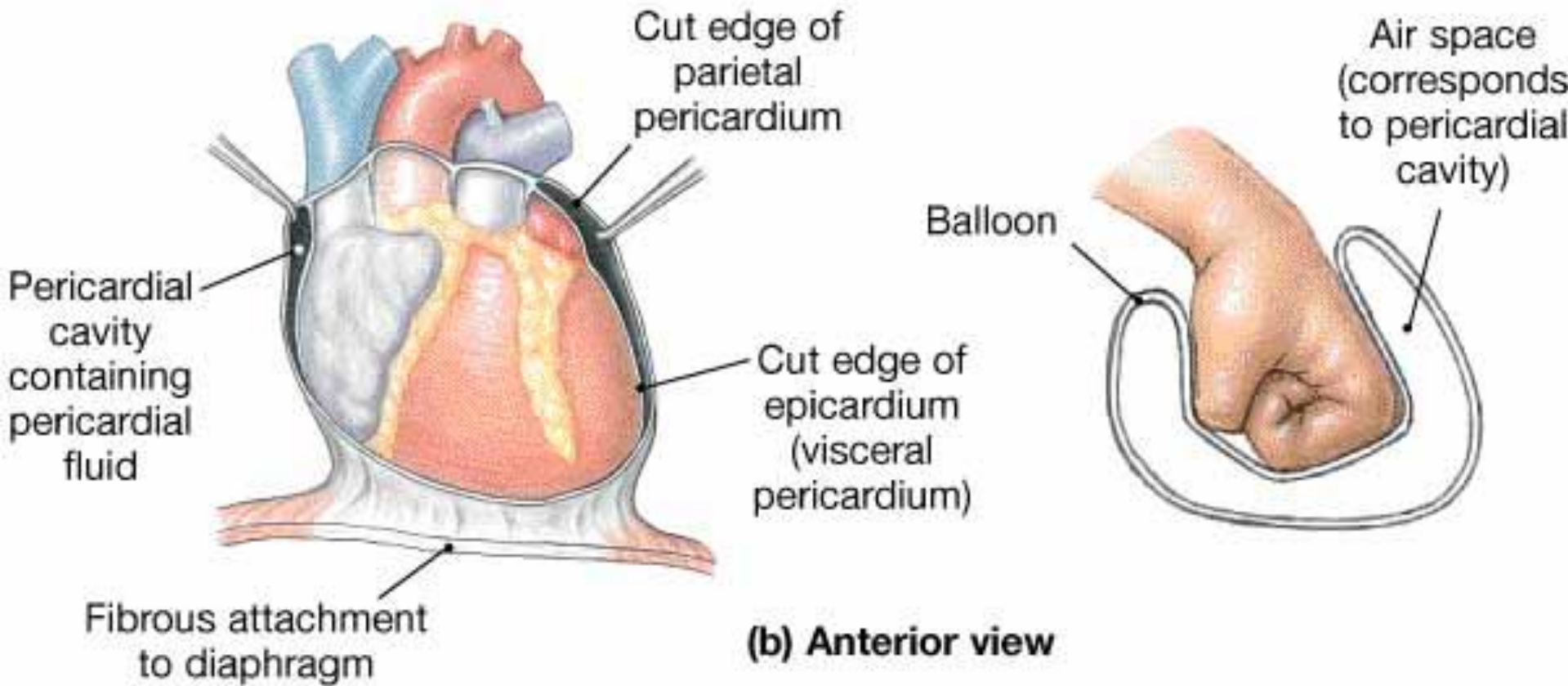
(a) Anterior view

Figure 21-05a2: Cadaver (anterior view)



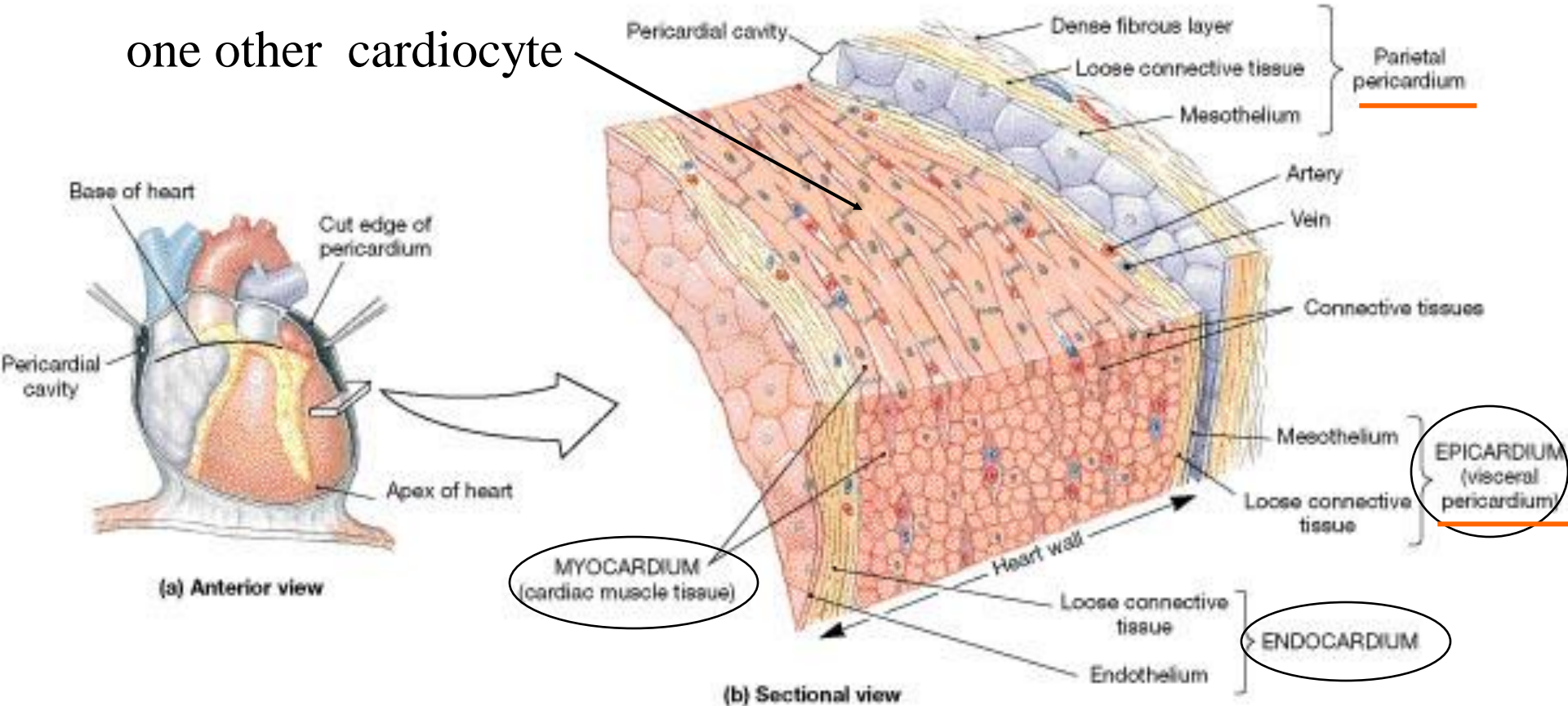
(a) Anterior (sternocostal) surface

Figure 21-02b: *The pericardium (anterior view)*



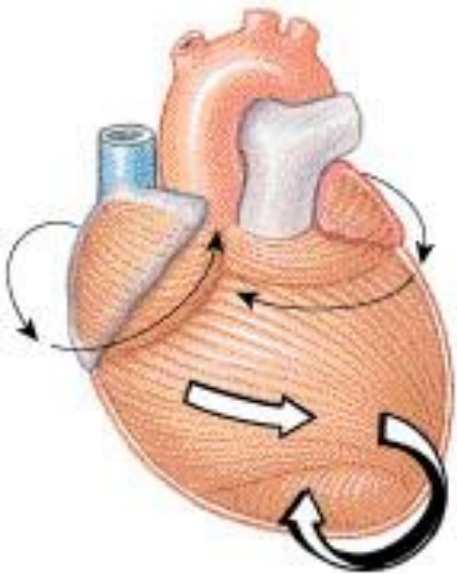
# Figure 21-03a: Cardiac muscle tissue

NB: a single cardiocyte connects with more than one other cardiocyte

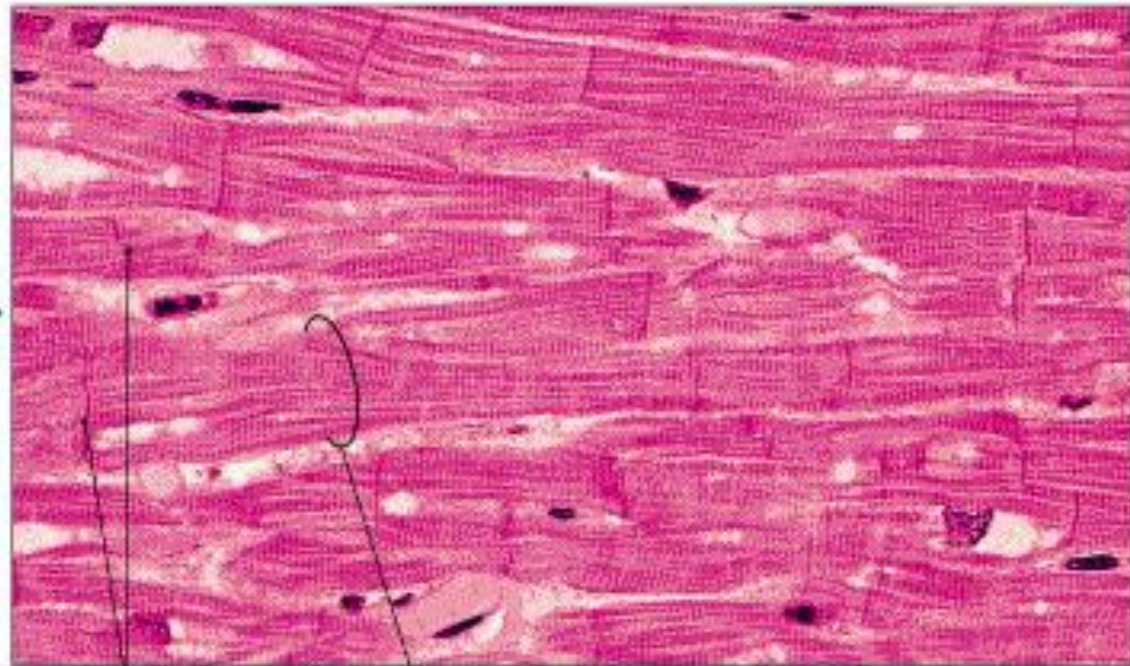


NB: three layers of the heart (endocardium, myocardium, epicardium)

Figure 21-03c: *Cardiac muscle tissue (histology)*



(c) Anterior view



Intercalated discs

Cardiac muscle cell (cardiocyte)

(d) Cardiac muscle tissue x 350

# Figure 21.3 Organization of Muscle Tissue in the Heart Wall

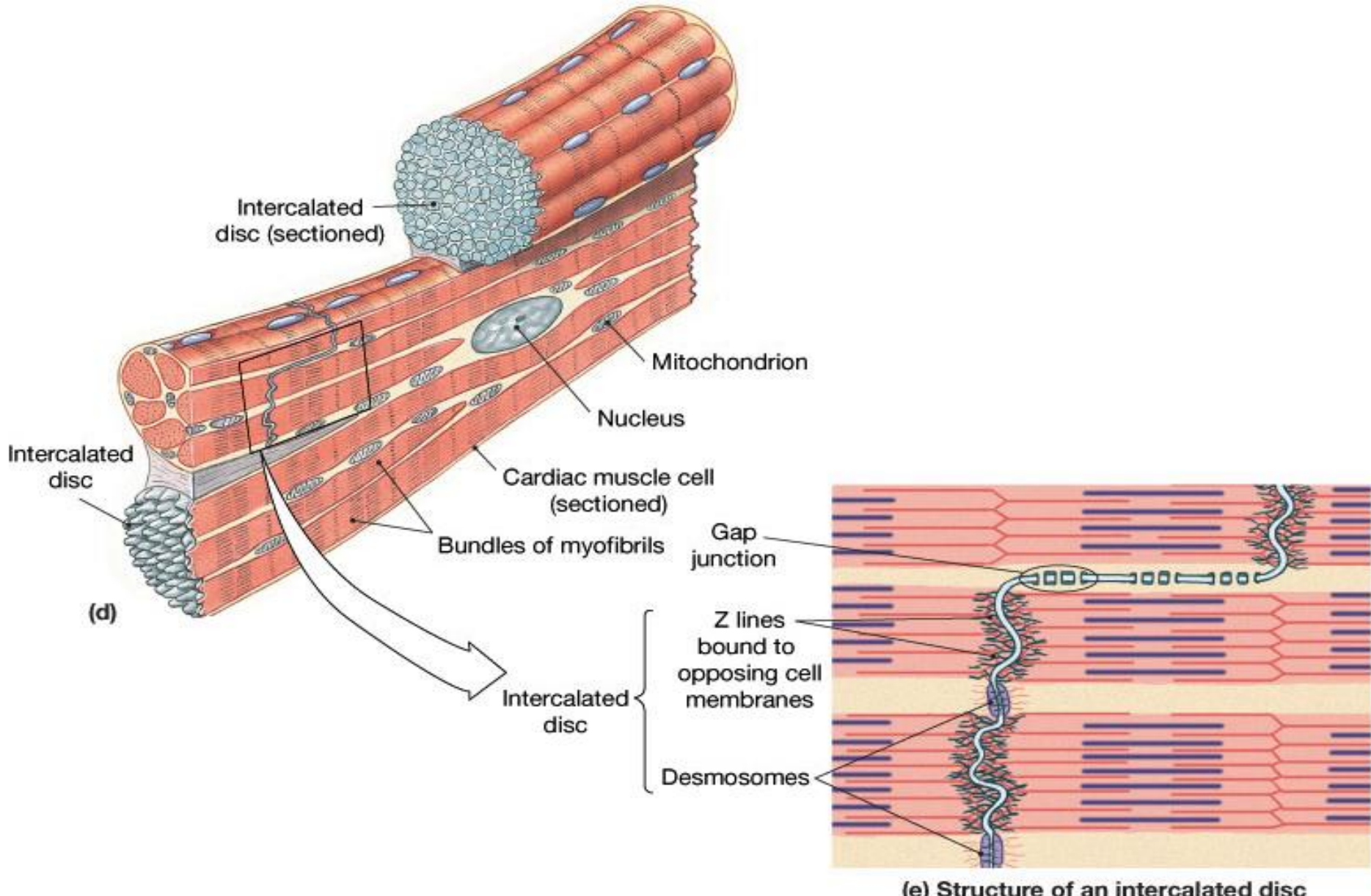


Figure 21-04: *Position and orientation of the heart*

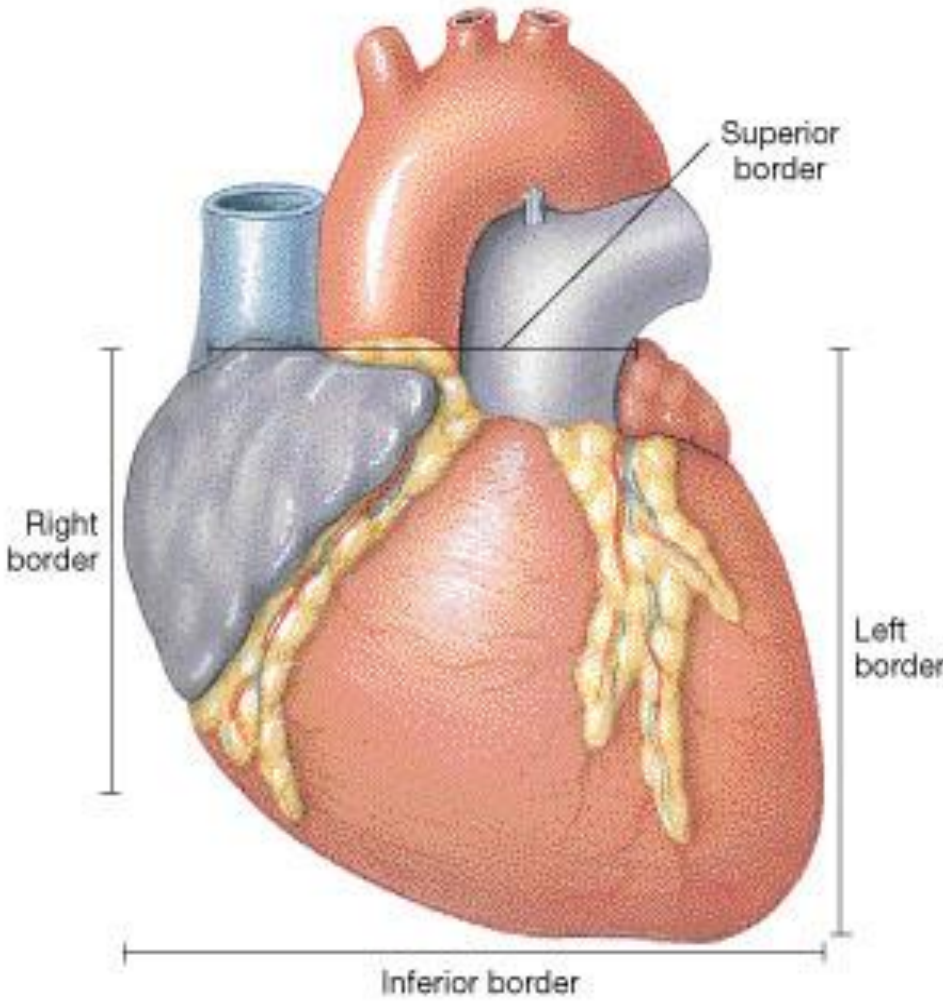
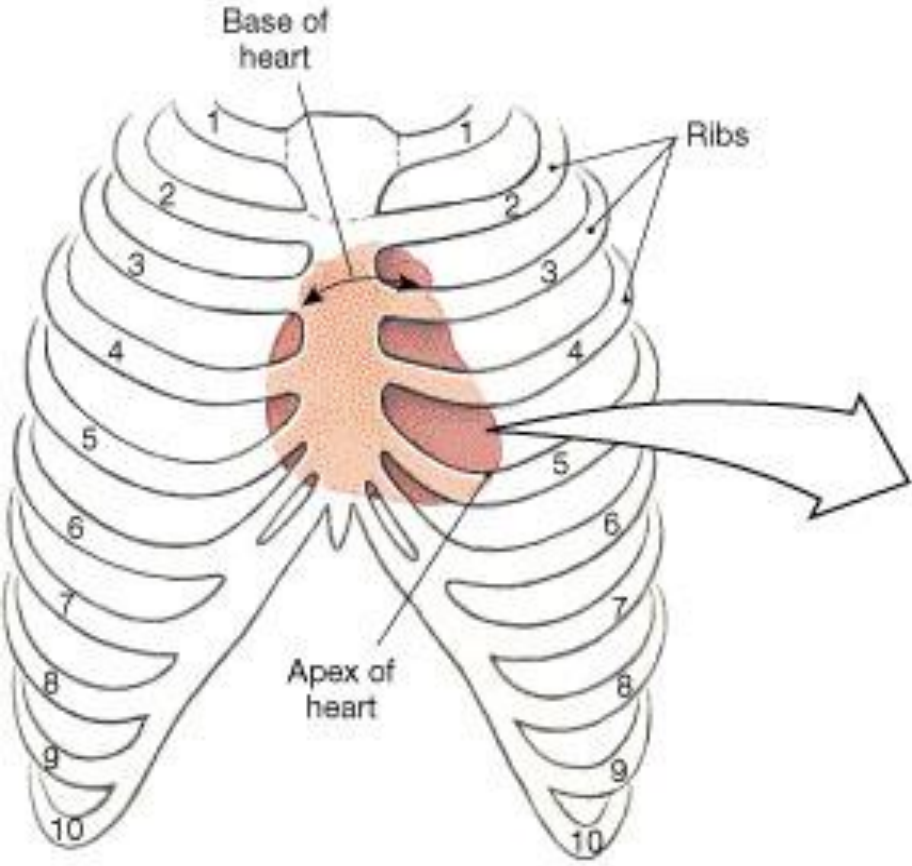
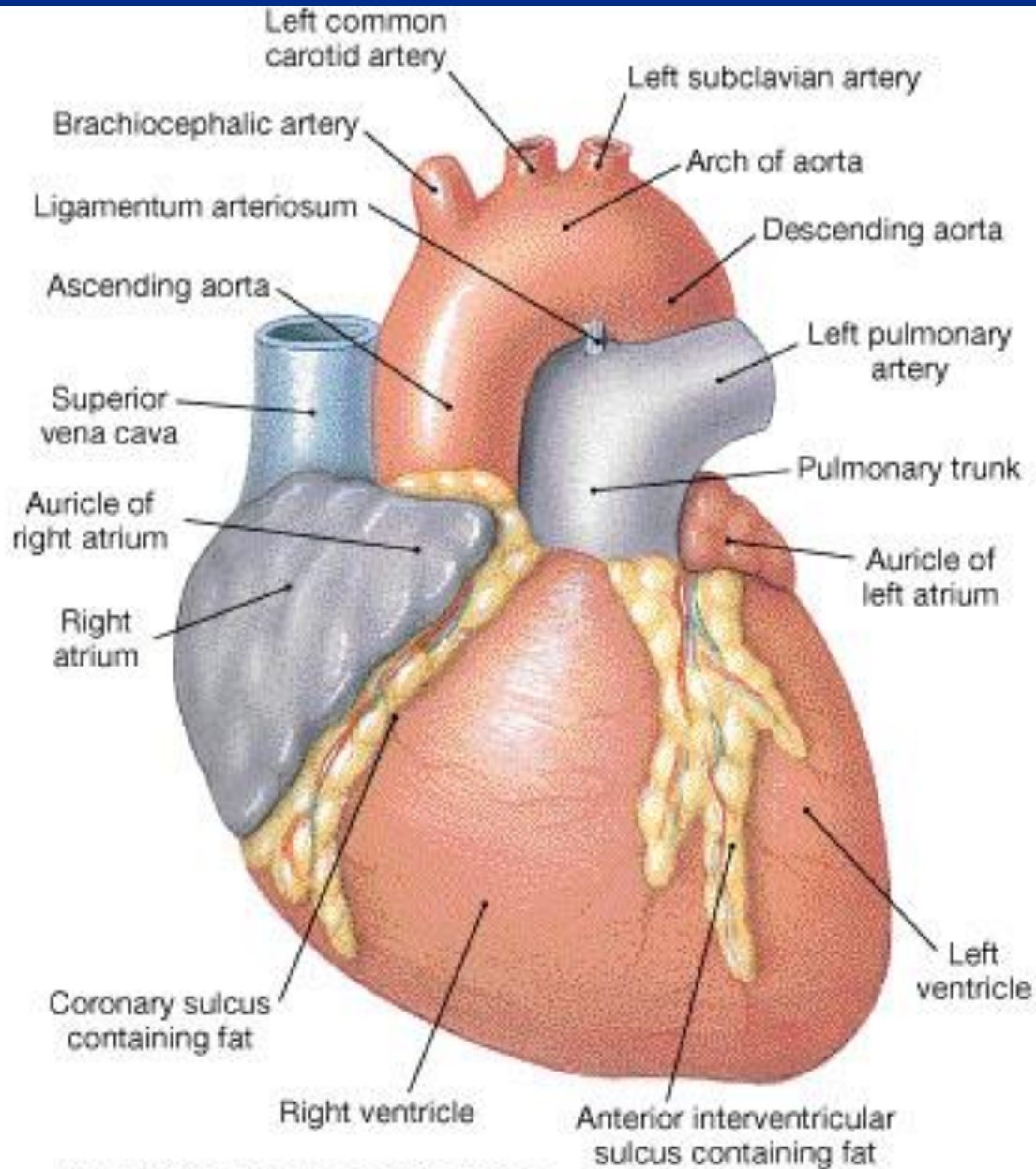


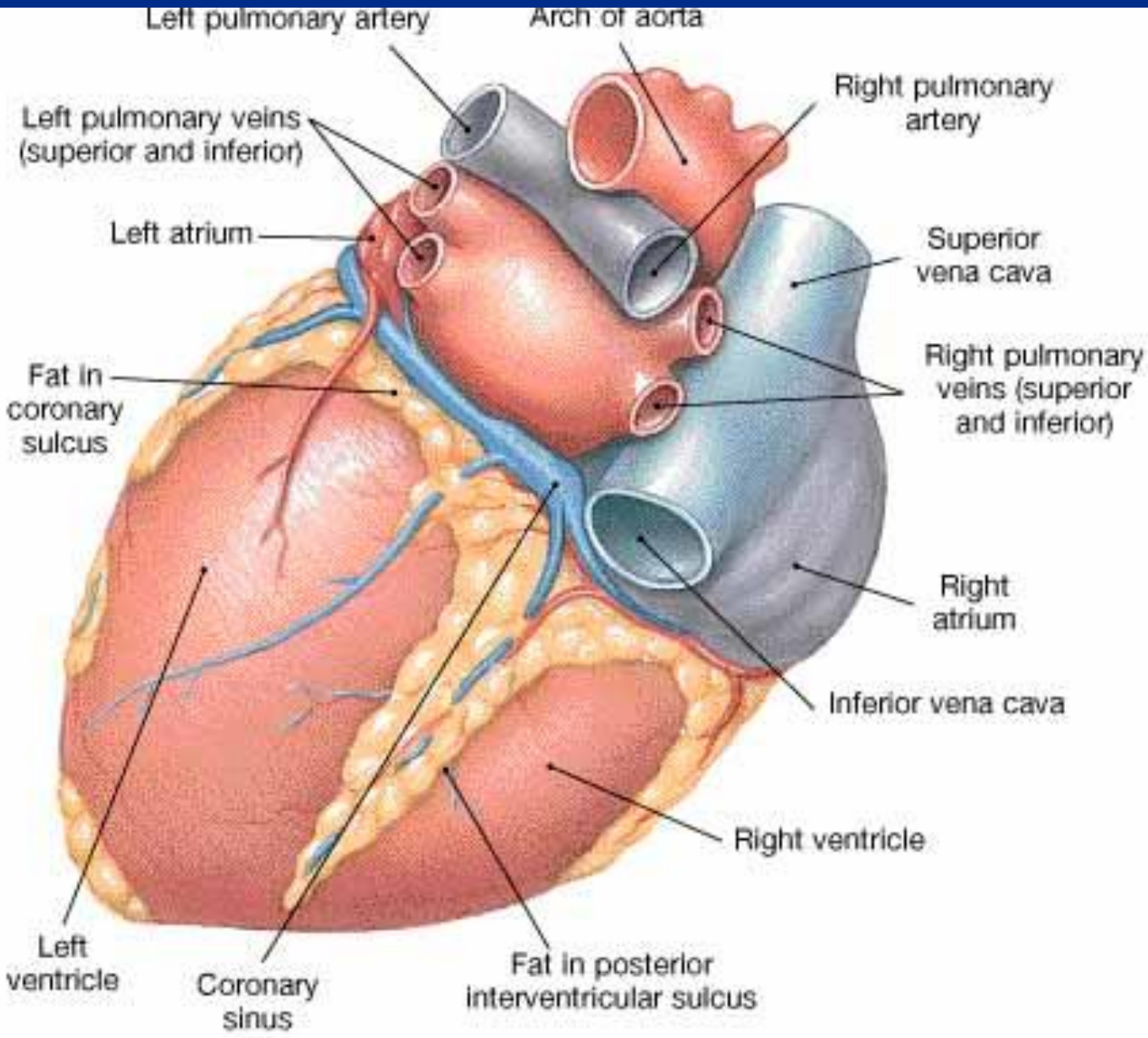
Figure 21-05a1: *External structures of the heart (ant)*



**(a) Anterior (sternocostal) surface**

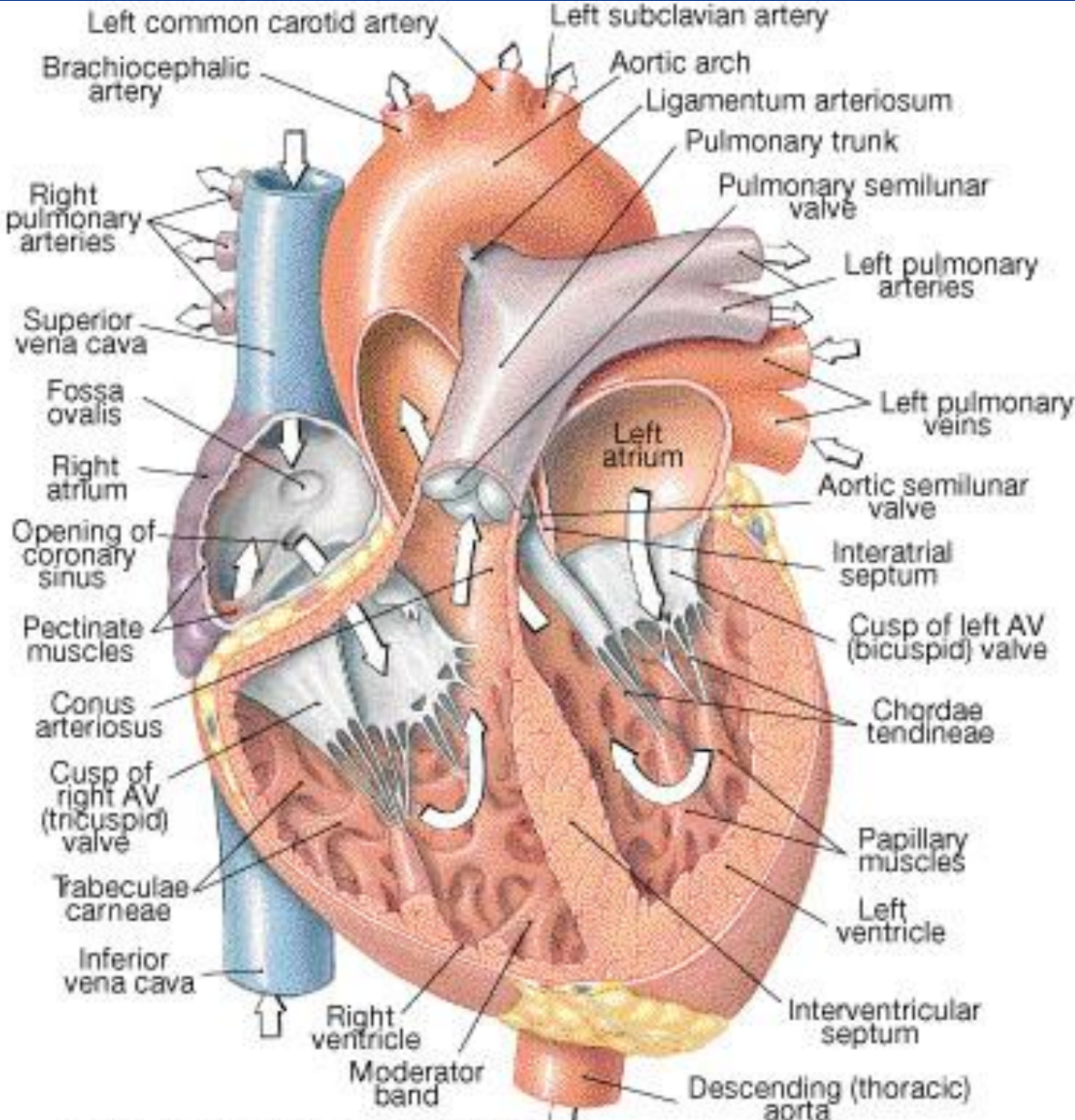


Figure 21-05b1: External structures of the heart (post)



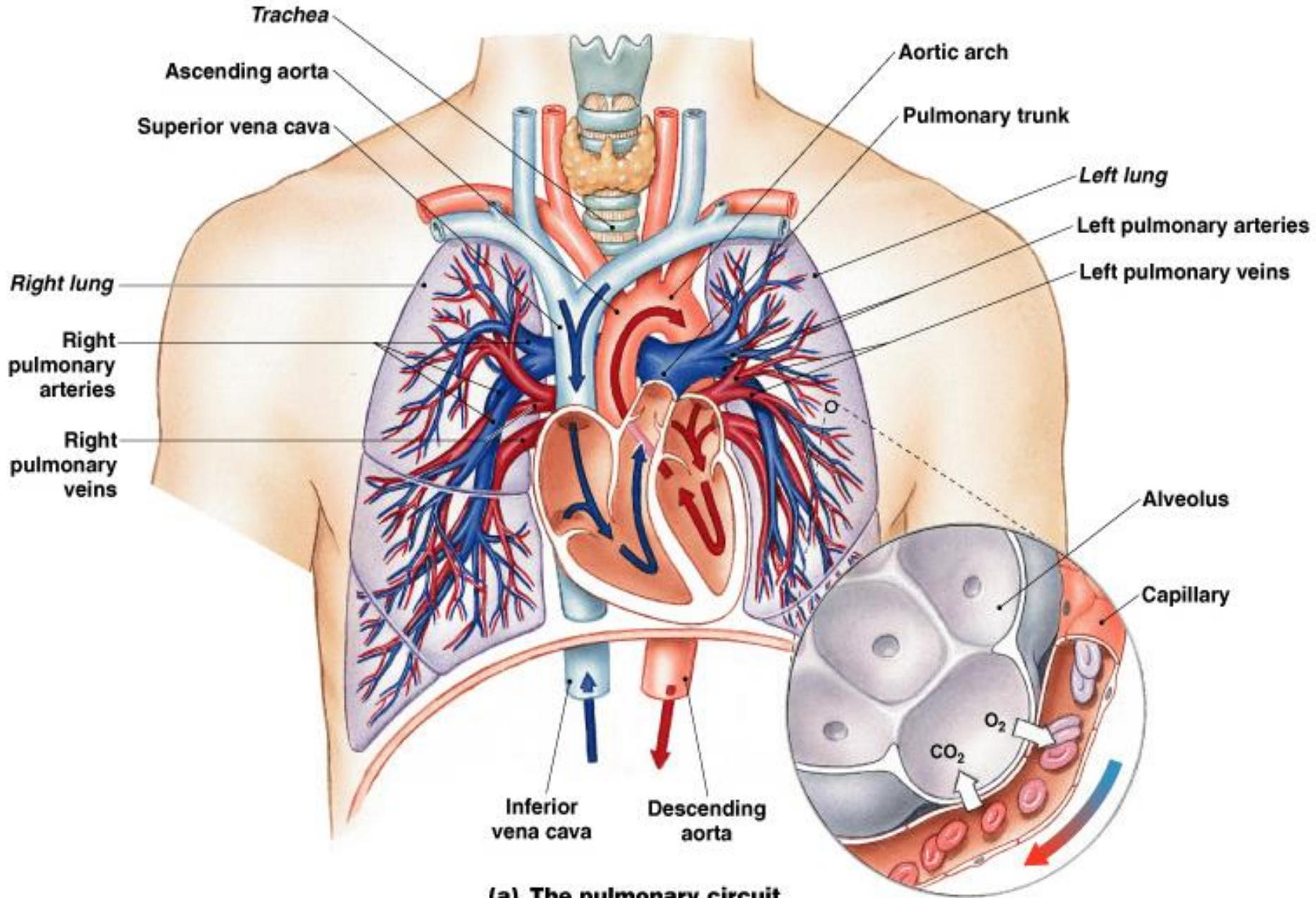
(b) Posterior (diaphragmatic) surface

Figure 21-06a: Blood flow through the heart



(a) Frontal section, anterior view

# The Pulmonary Circuit



## Valves of the Heart

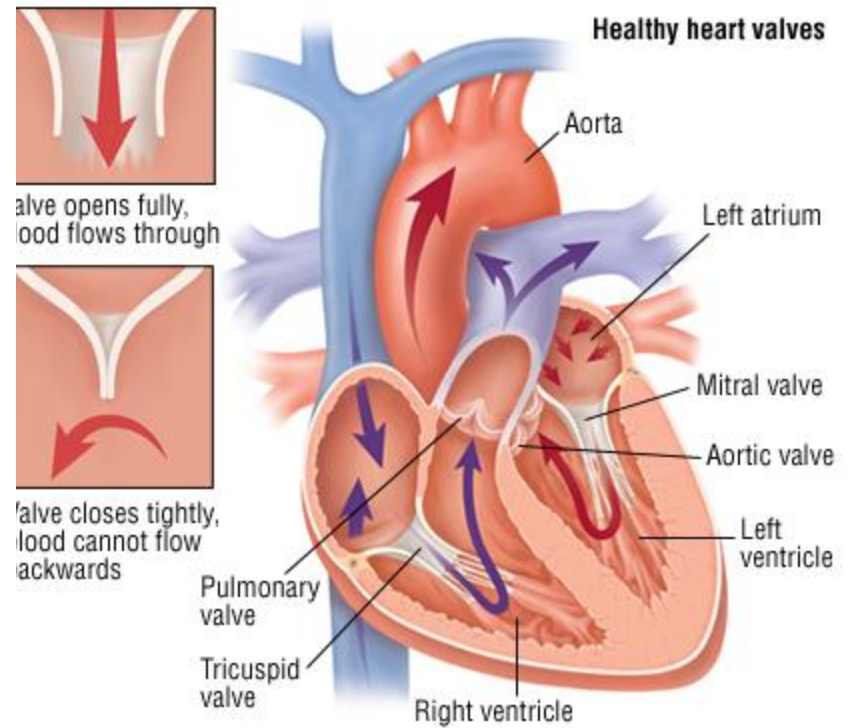
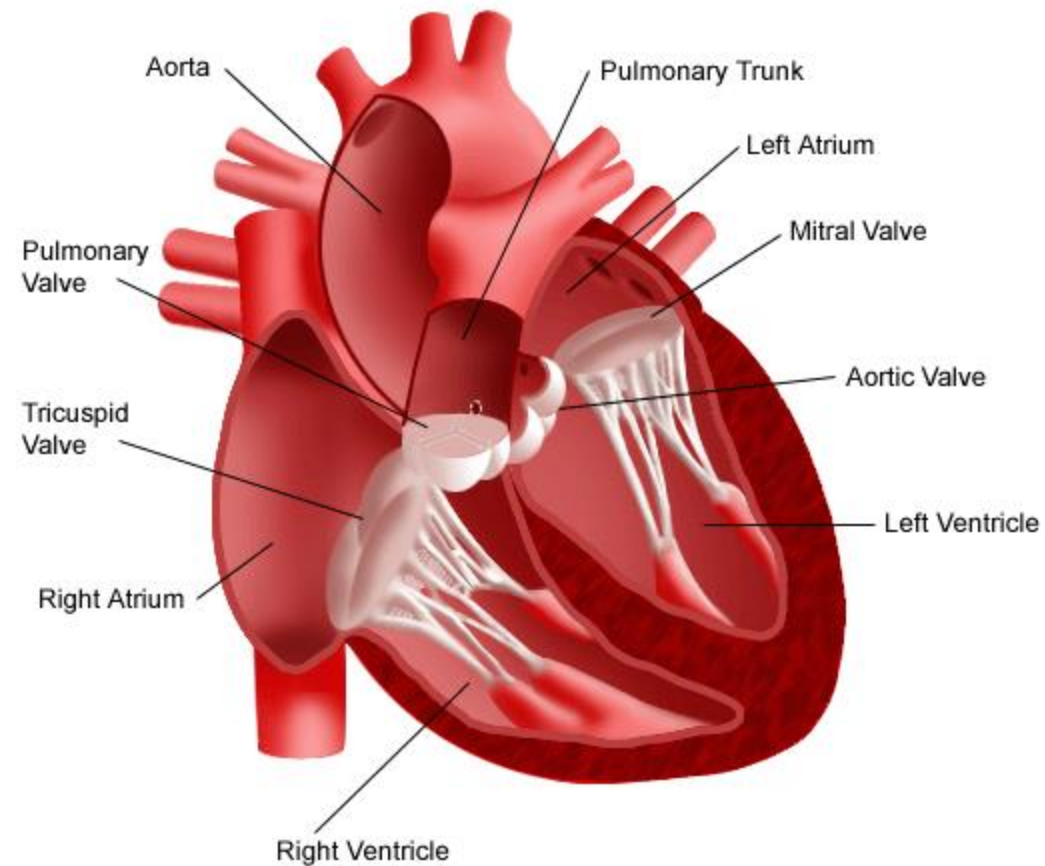
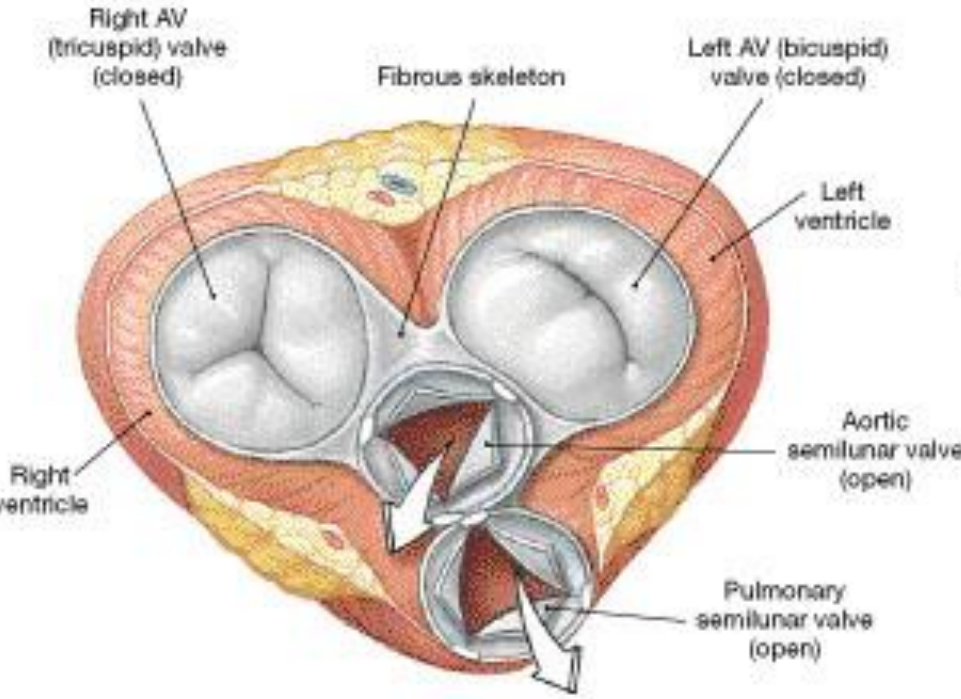


Figure 21-07b: Ventricular systole

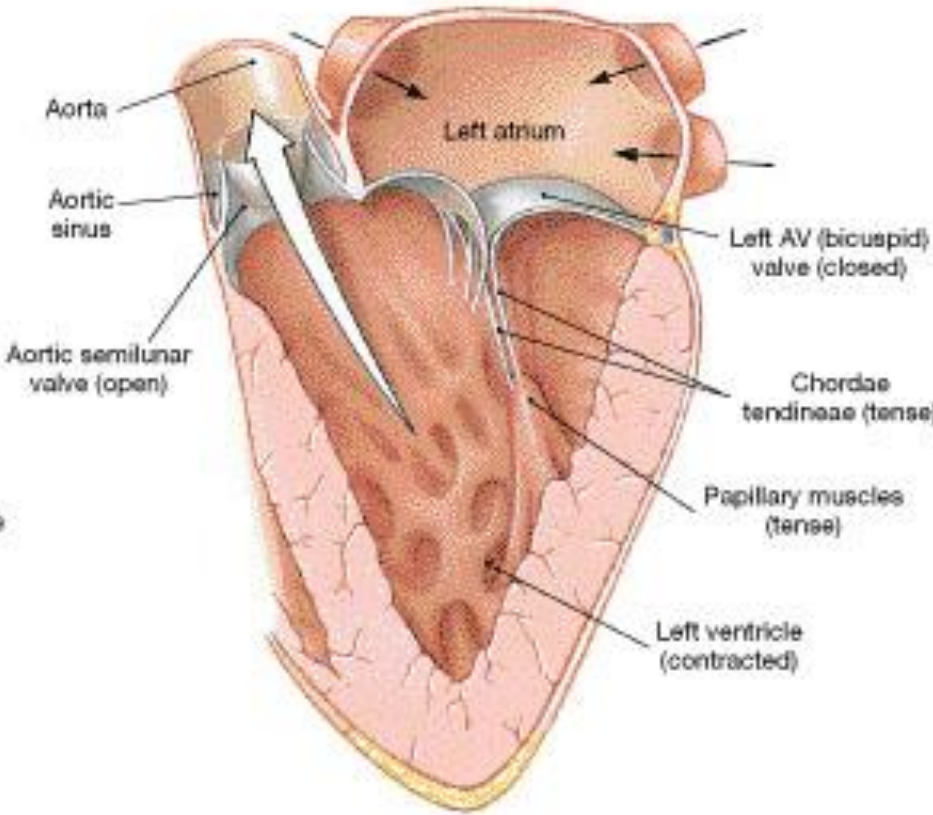
TRANSVERSE SECTION, SUPERIOR VIEW  
(atria and great vessels removed)



TRANSVERSE SECTION

(b) Ventricular systole (contraction)

FRONTAL SECTION  
(through left atrium and ventricle)



FRONTAL SECTION

Figure 21-07a: *Ventricular diastole (valve function)*

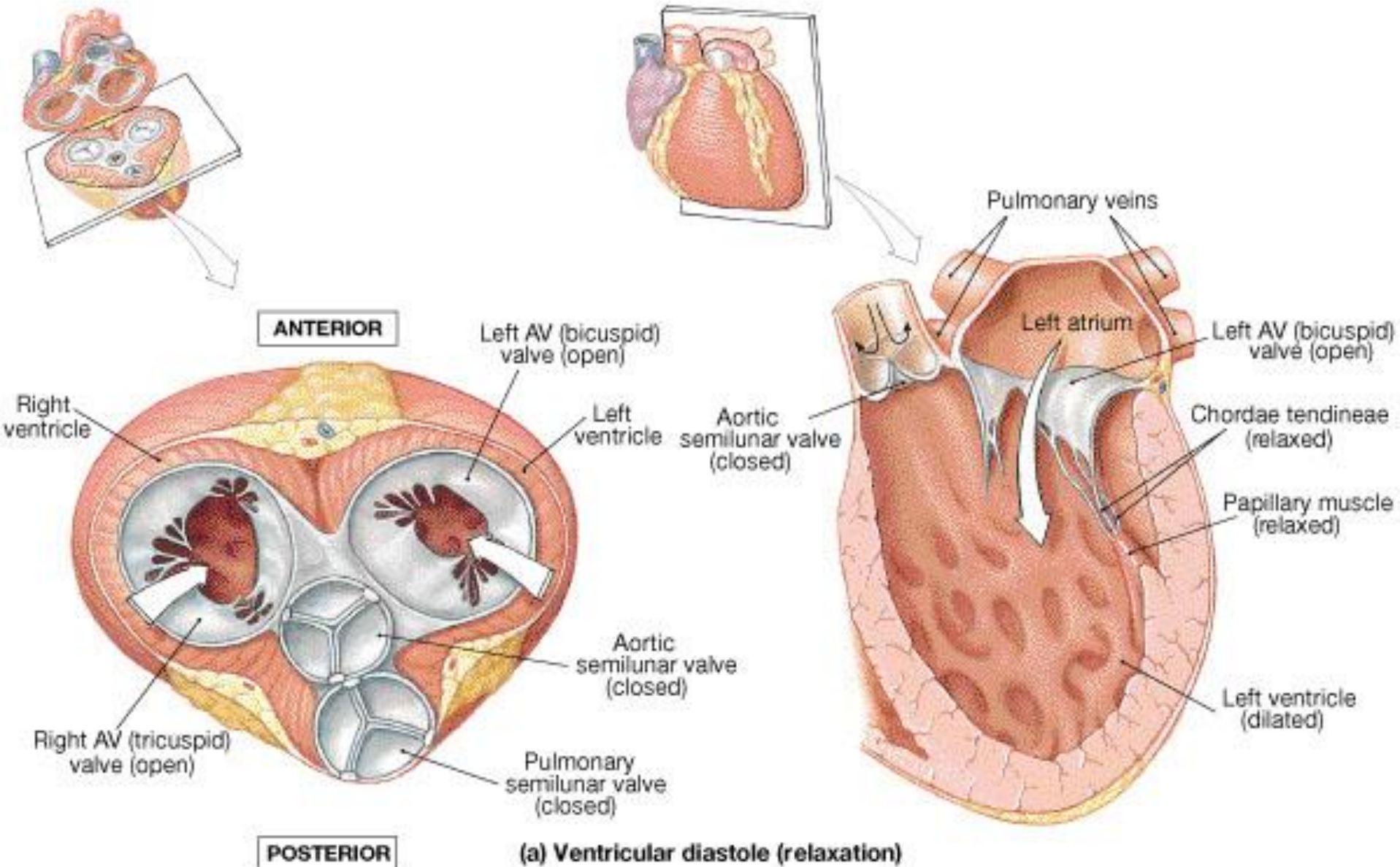
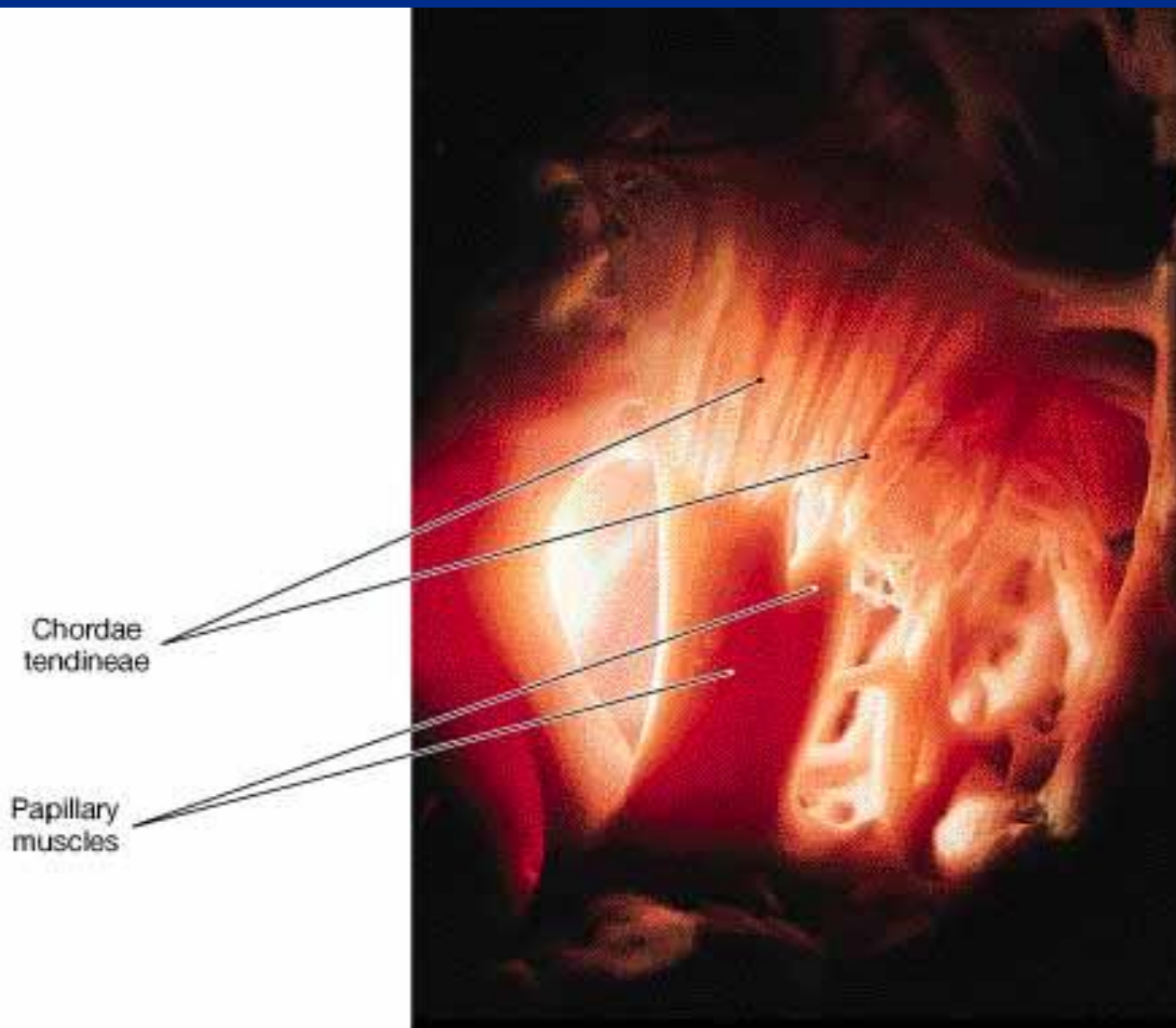


Figure 21-06b: *Papillary muscle and chordae tendinae*



(b) Interior view, right ventricle

# The Aortic Arch





Figure 21-11: Cardiac cycle

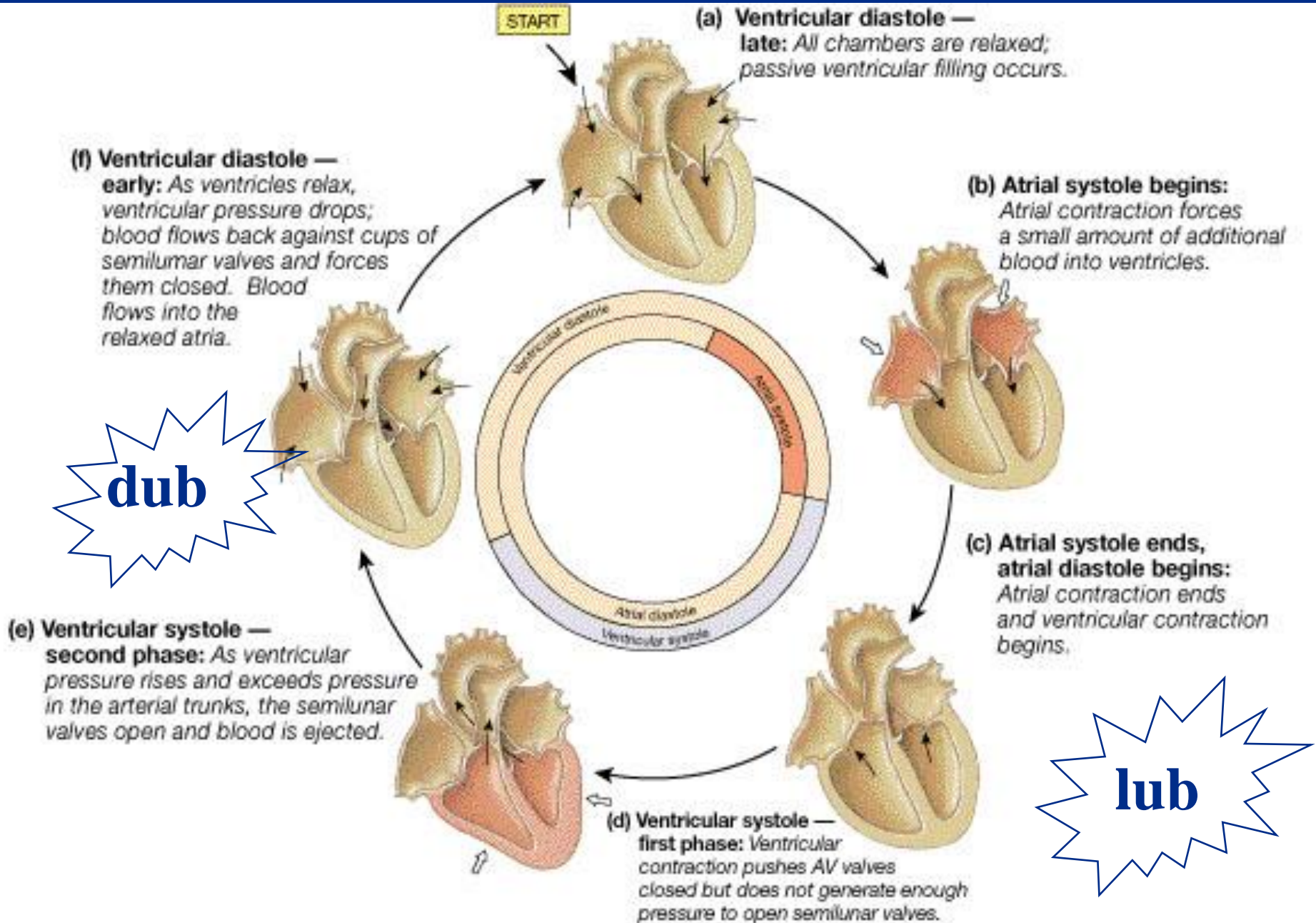


Figure 21-08: Heart valves and sounds

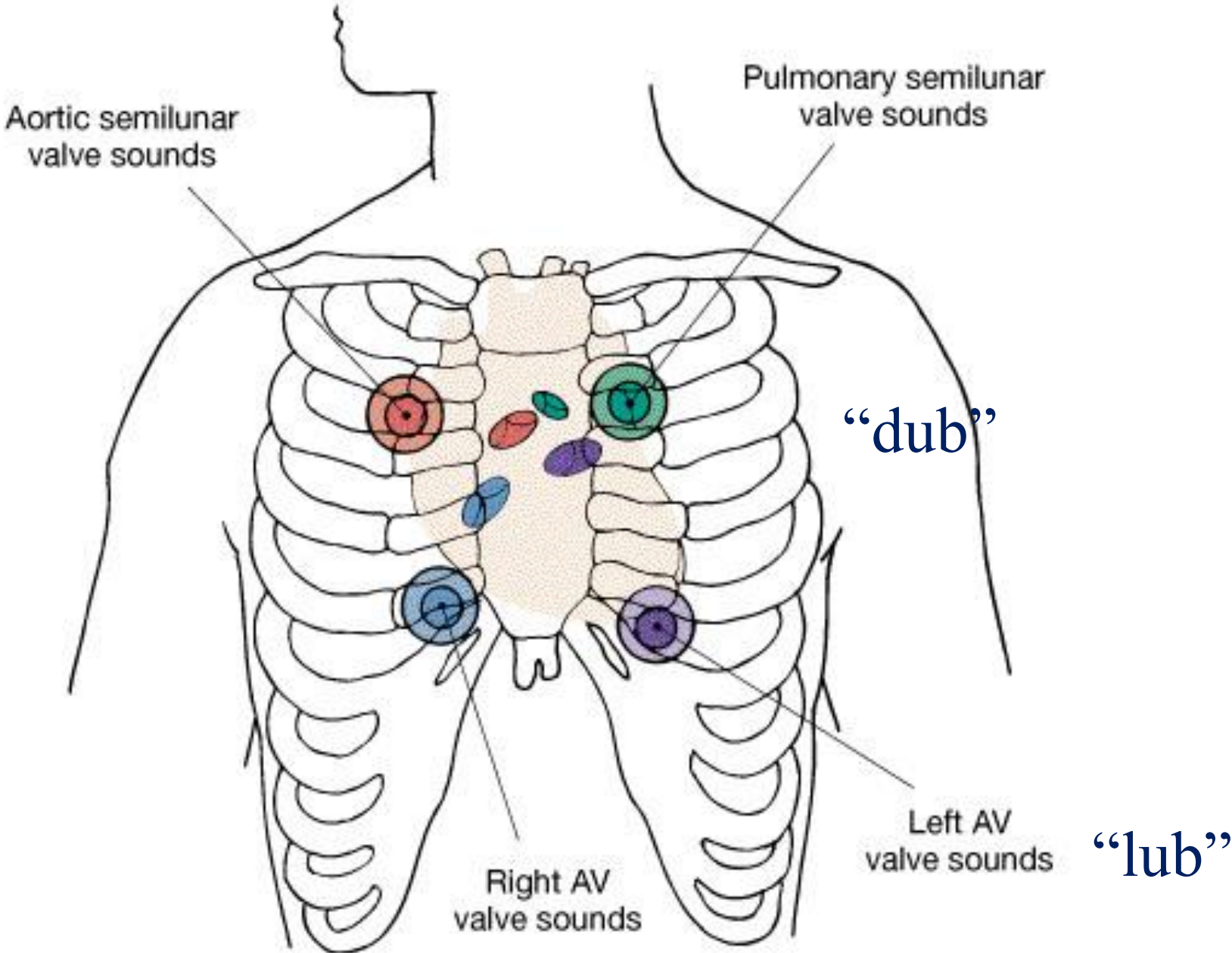


Figure 21-09a: Coronary vessels (anterior view)

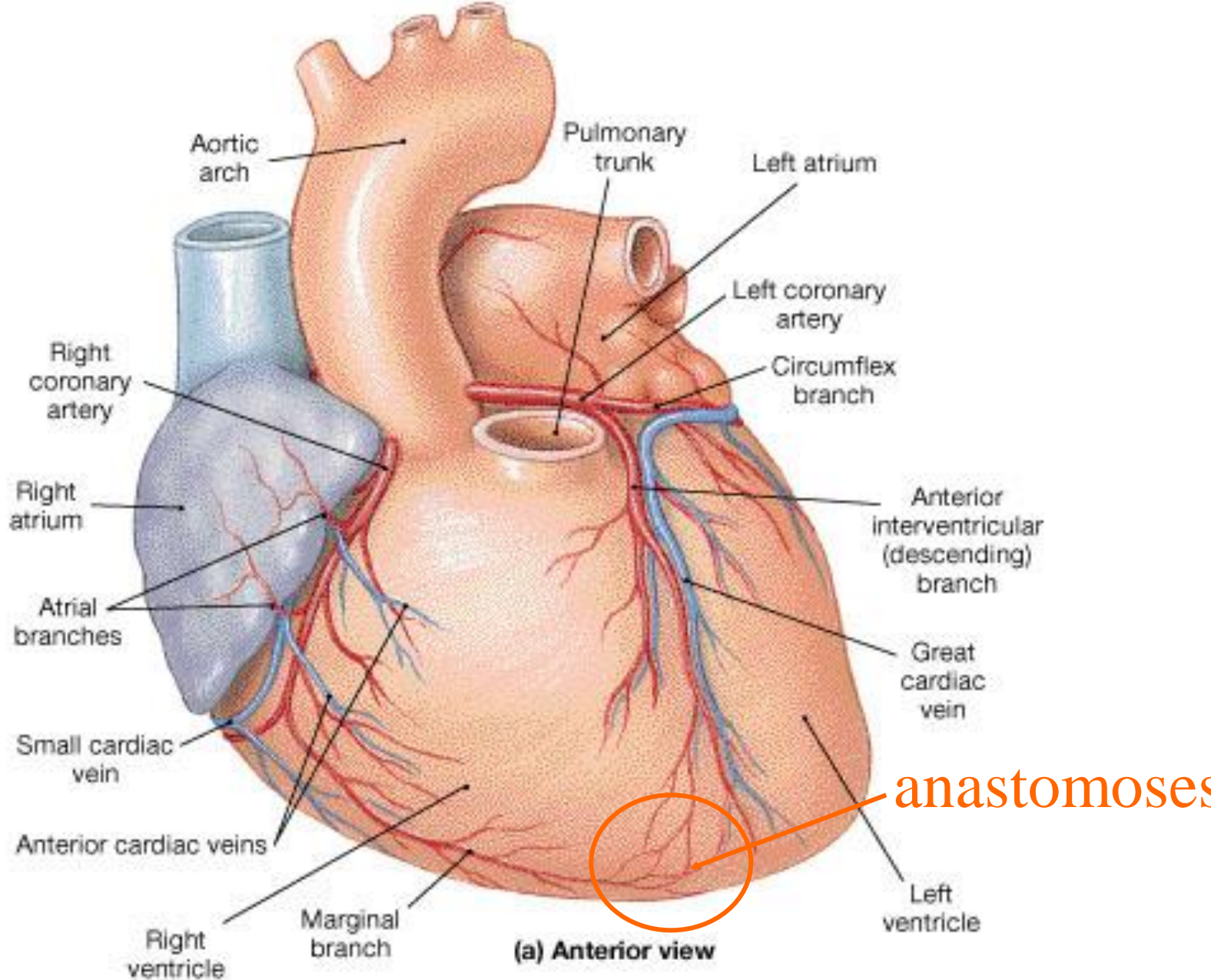
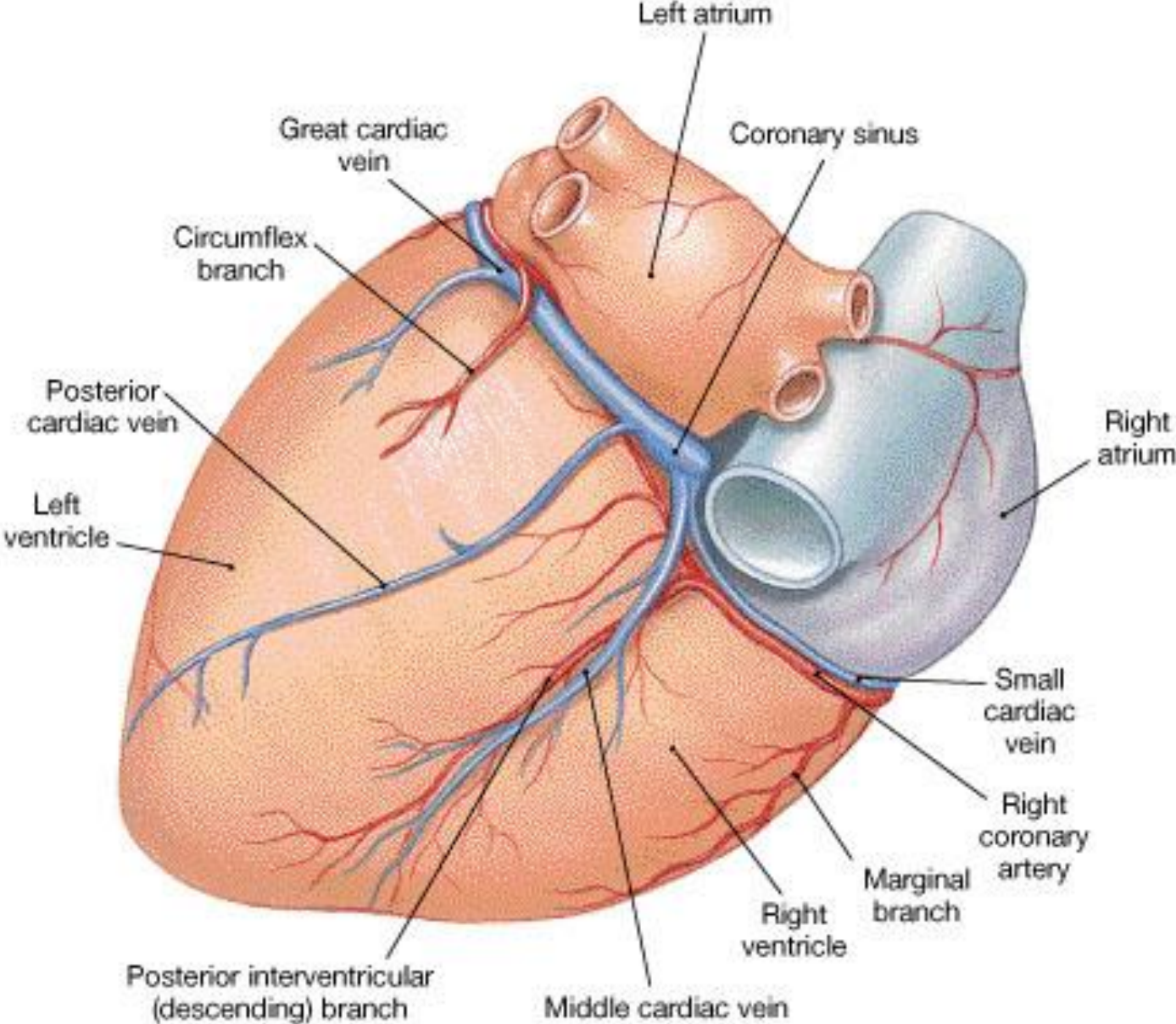
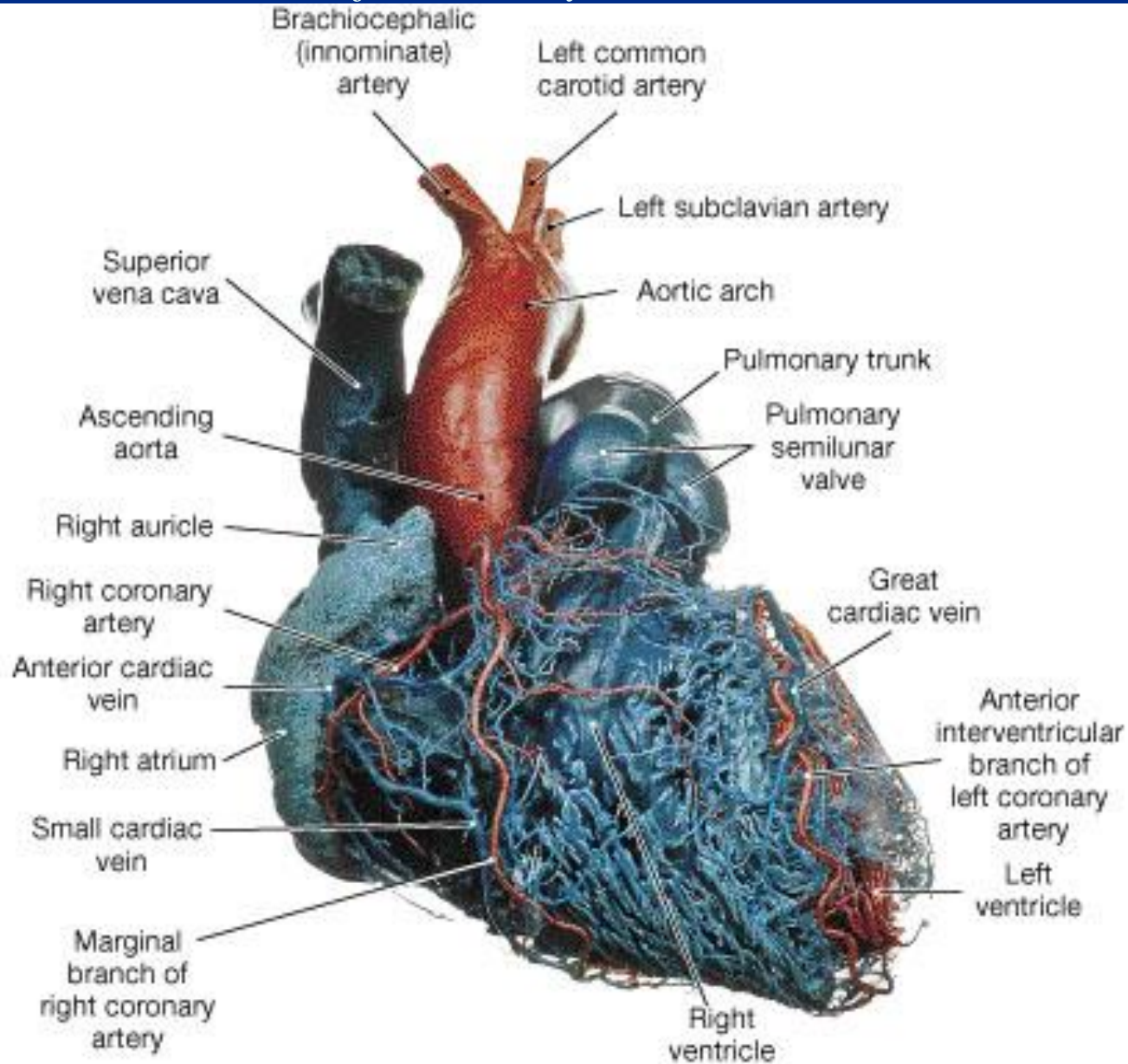


Figure 21-09b: Coronary vessels (posterior view)



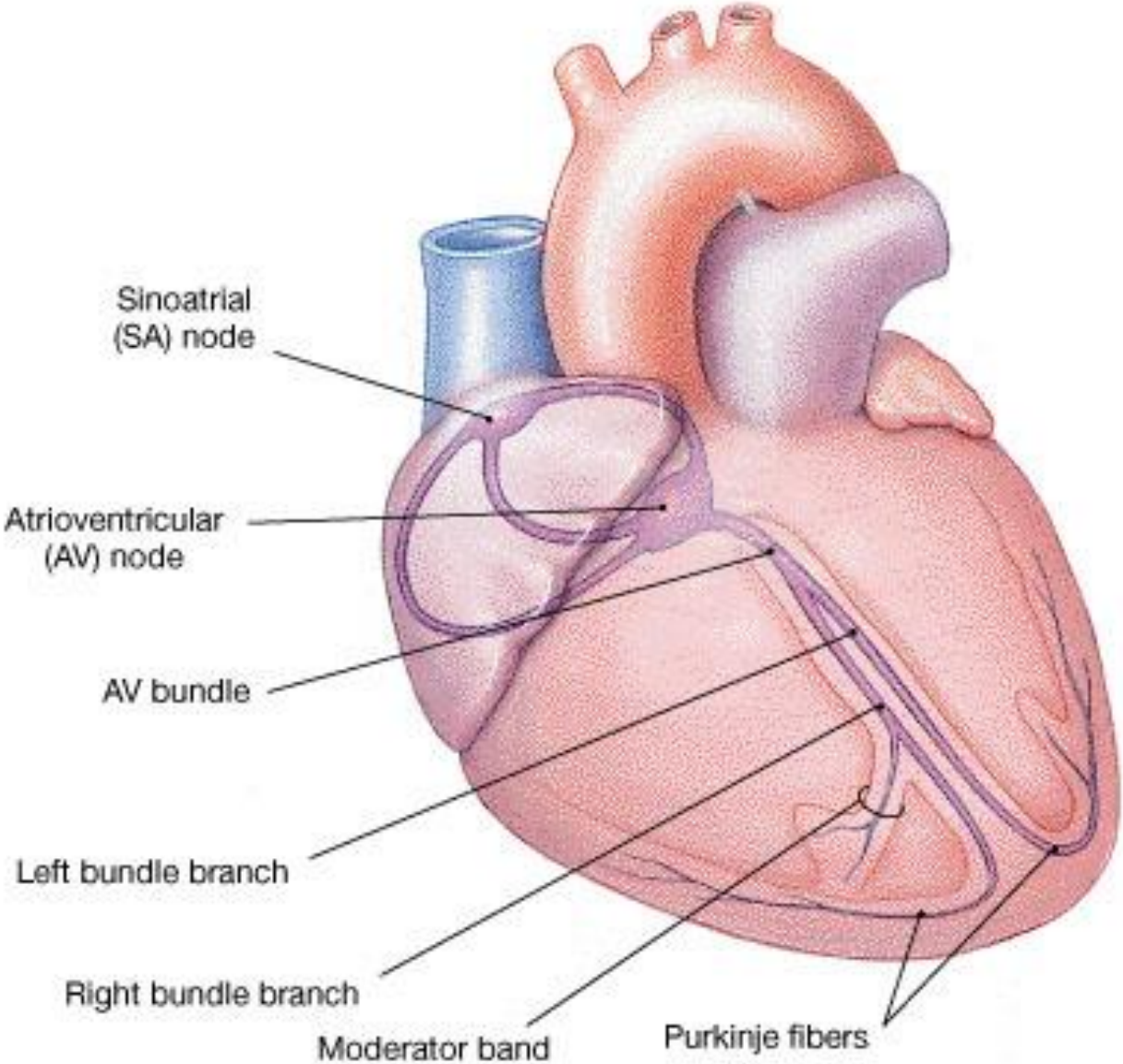
(b) Posterior view

# Figure 21-09c *Cast of coronary vessels*



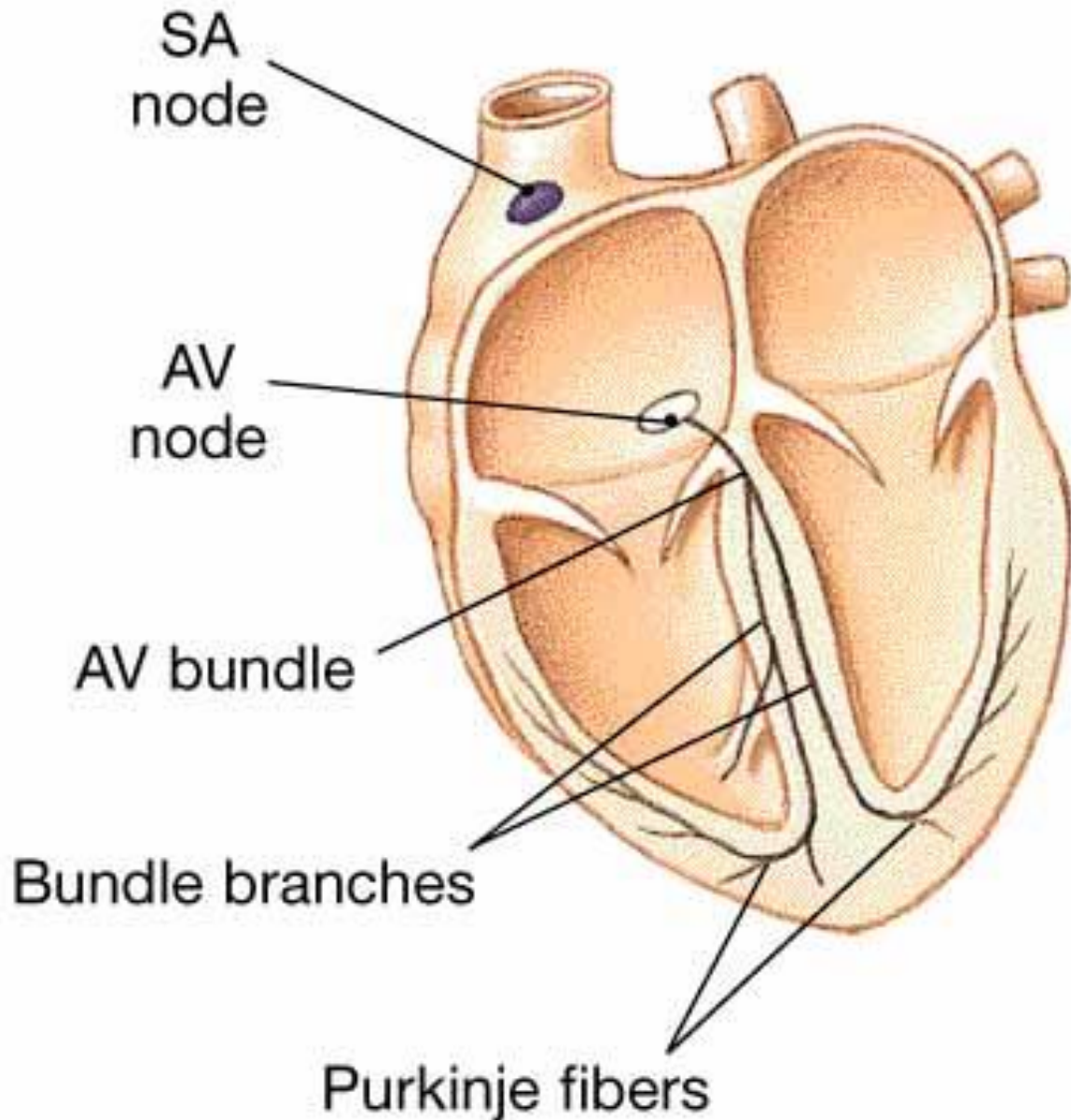
(c) Coronary circulation and great vessels, anterior view

# Control of Heart Rate: *Nodes and conducting fibers*



(a) Nodes and conducting fibers

Figure 21-12b: *Conducting system (step 1)*

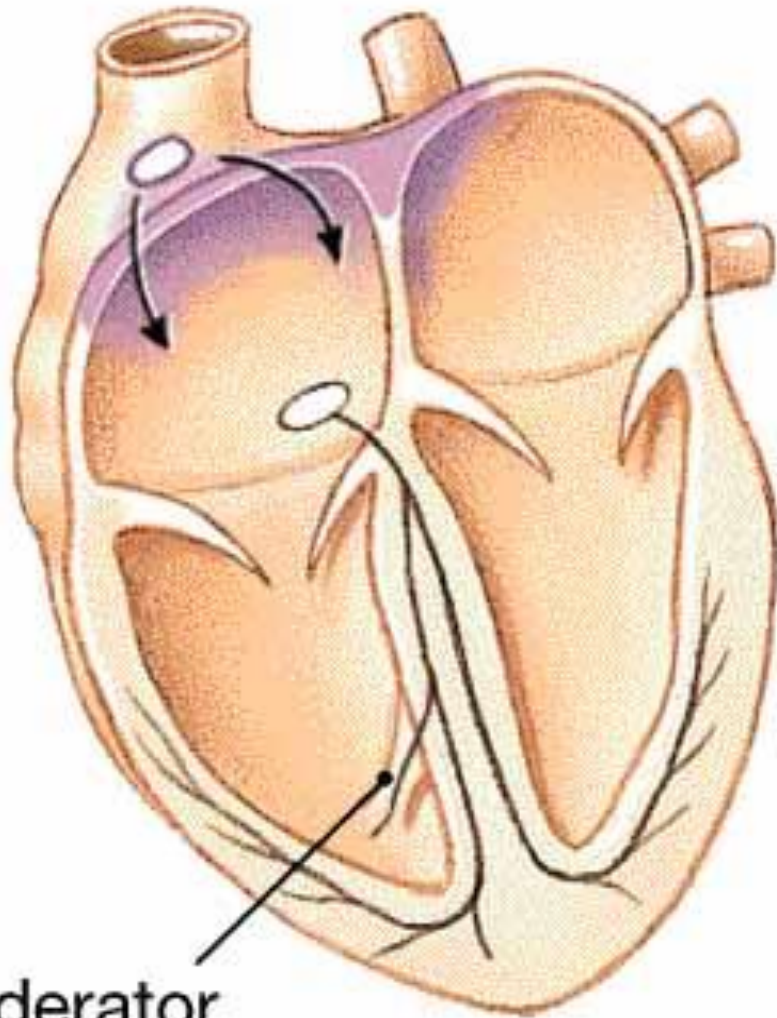


**STEP 1:**  
SA node activity  
and atrial  
activation begin.

Time = 0



Figure 21-12c: *Conducting system (step 2)*



**STEP 2:**

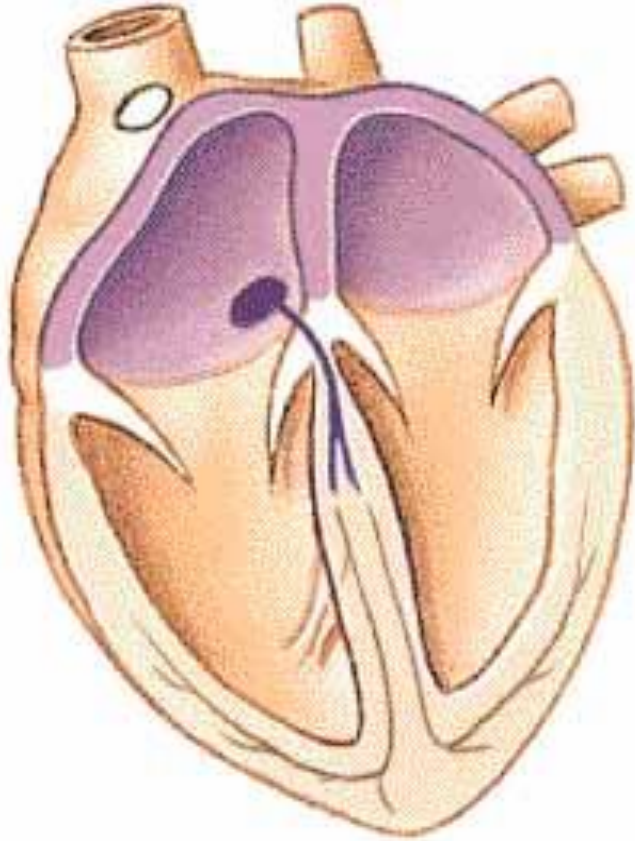
Stimulus reaches  
the AV node.

Elapsed time = 50 msec

Moderator  
band

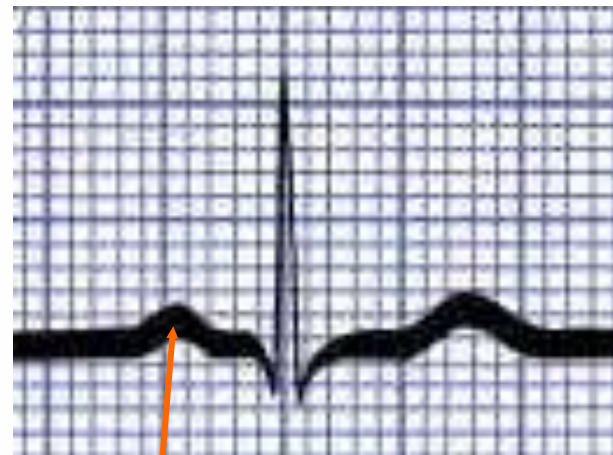


Figure 21-12d: *Conducting system (step 3)*



**STEP 3:**  
There is a 100 msec delay at the AV node. Atrial contraction begins.

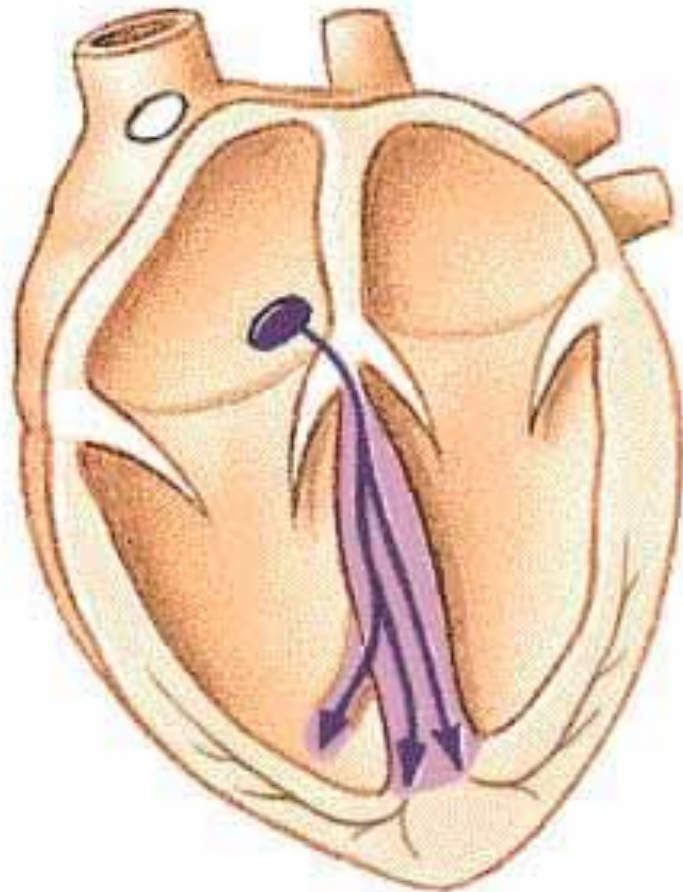
Elapsed time = 150 msec



'P' wave of EKG



Figure 21-12e: *Conducting system (step 4)*



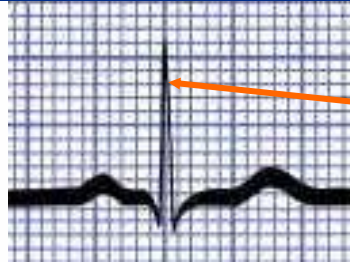
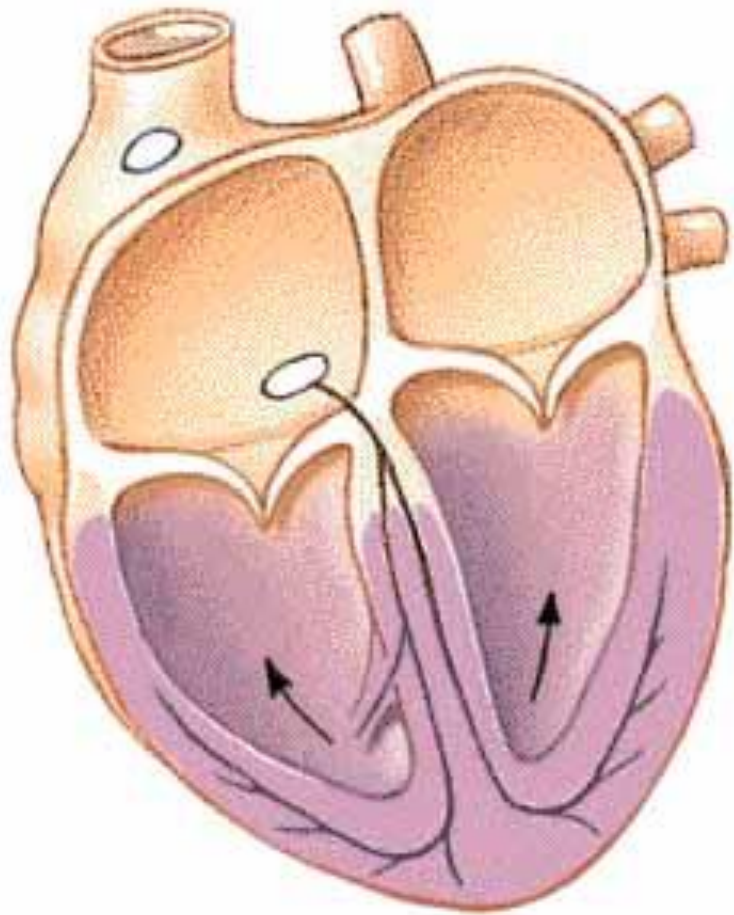
**STEP 4:**

The impulse travels along the interventricular septum via the AV bundle and the bundle branches, to the Purkinje fibers.

Elapsed time = 175 msec



Figure 21-12f : *Conducting system (step 5)*



QRS complex of EKG

**STEP 5:**

The impulse is distributed by Purkinje fibers and relayed throughout the ventricular myocardium. Atrial contraction is completed, ventricular contraction begins.

Elapsed time = 225 msec

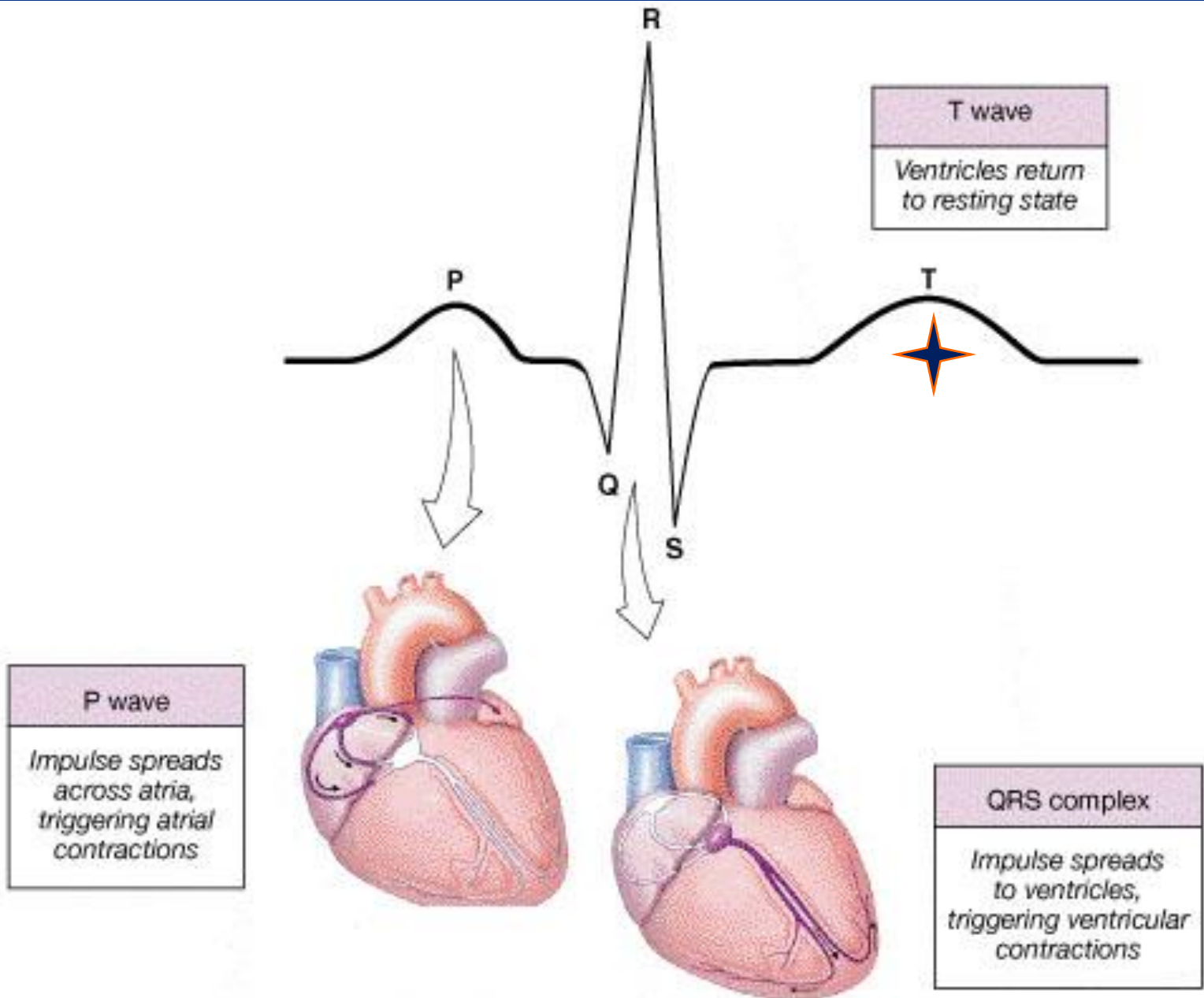
**(b) Steps in distribution of stimulus**

Figure 21-13a : An electrocardiogram

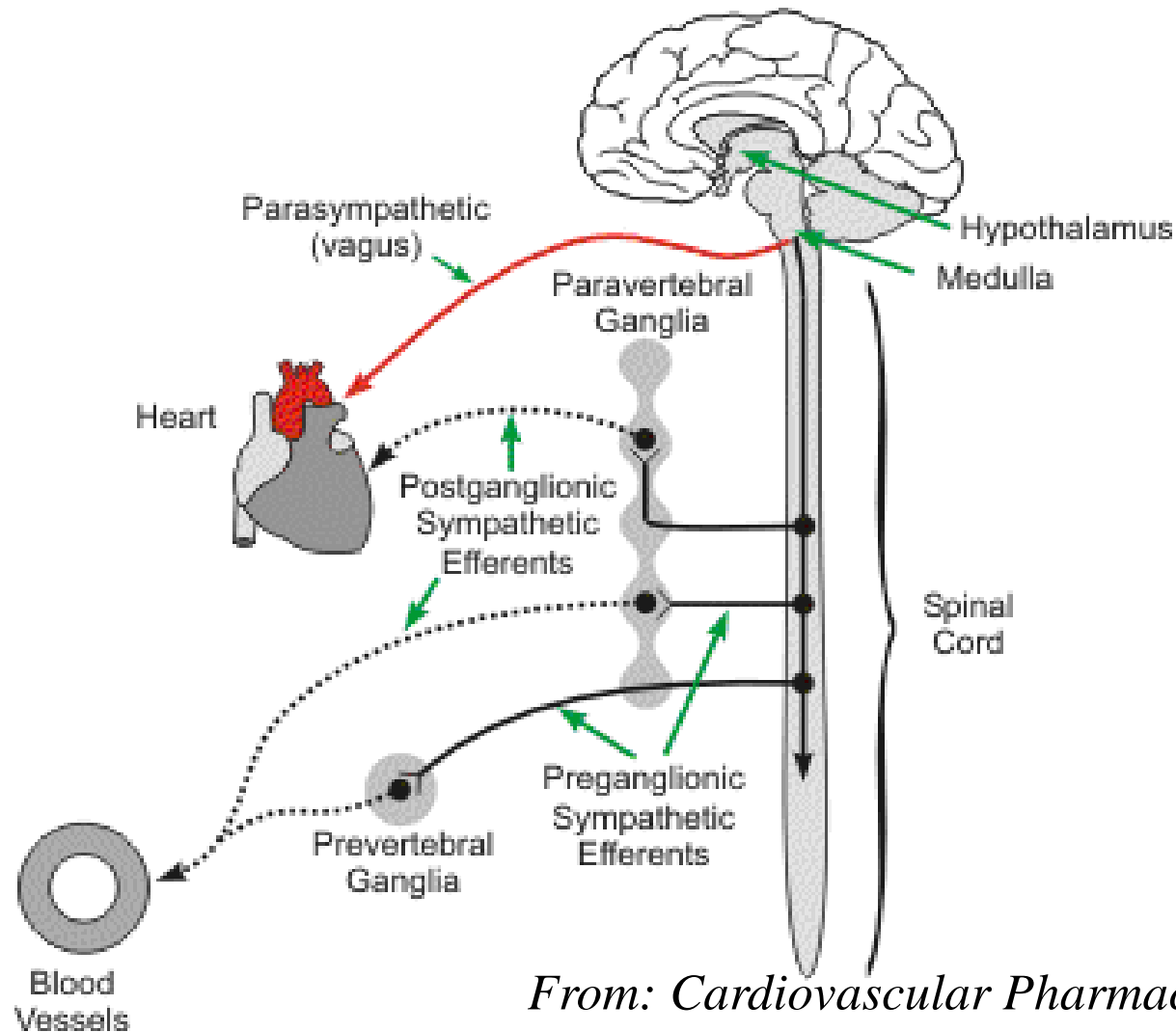


EKG rhythm strip

Figure 21-13b: *The ECG wave related to conduction*

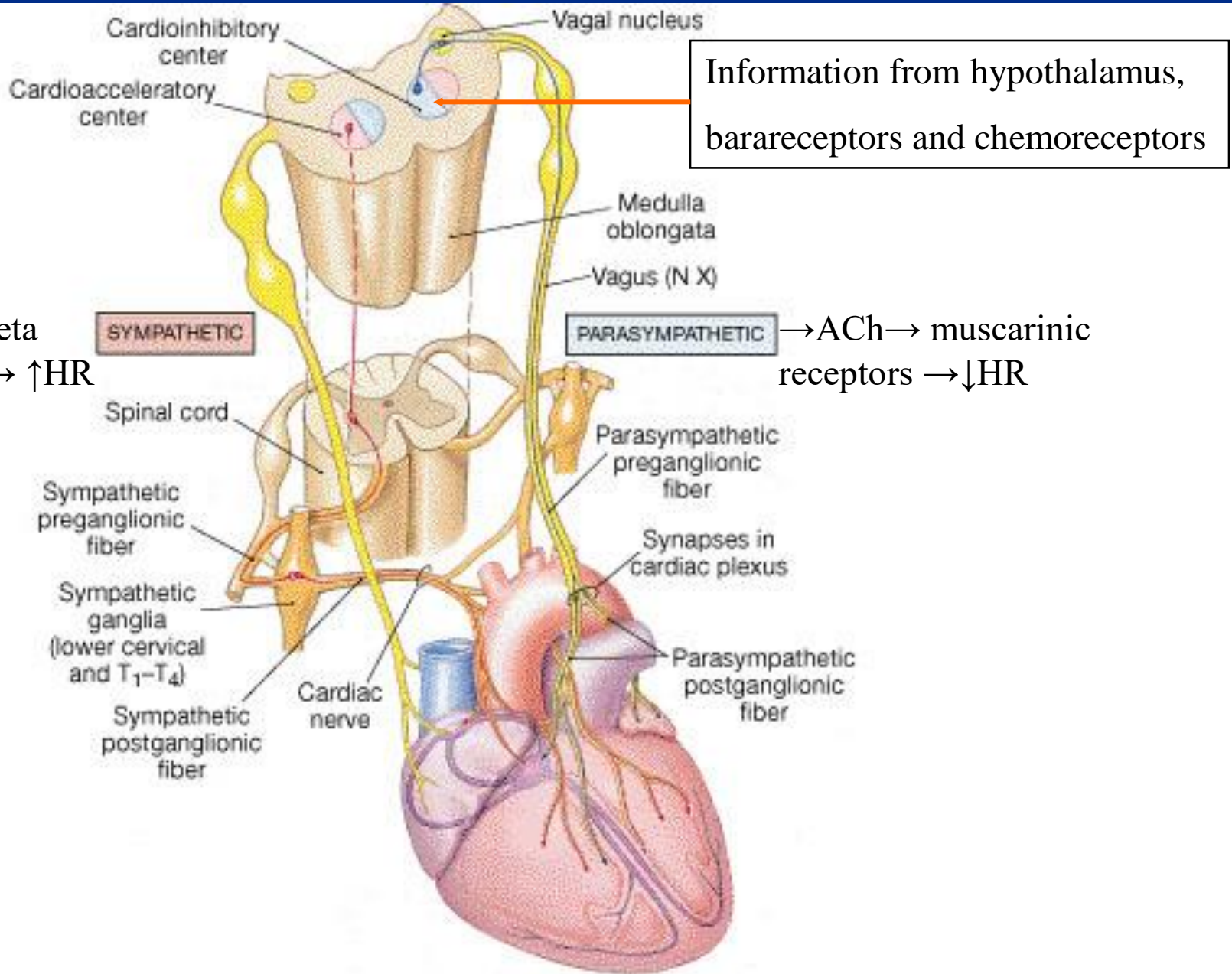


# Autonomic Nervous System: Control of heart rate



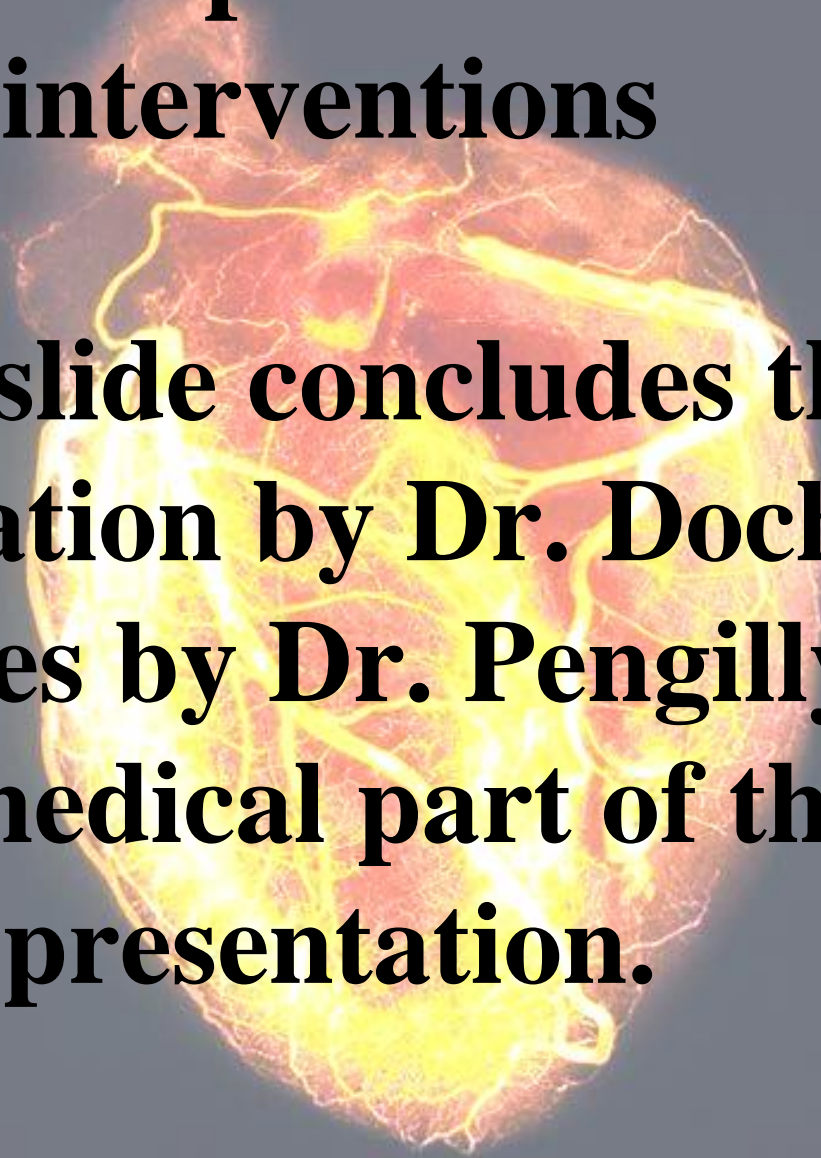
*From: Cardiovascular Pharmacology Concepts*

Figure 21-14: Autonomic innervation of the heart



# **Medical problems and interventions**

**This slide concludes the presentation by Dr. Docherty  
See slides by Dr. Pengilly for the medical part of this presentation.**





# Cardiology

Chris Pengilly

# Cardiology

In this address I hope to be able to cover the heart and circulation covering some of the the problems which can arise. Mostly, I will be referring to the investigations and some intervetions available to modern medicine.

My aim is to enable participants to have meaningful office visits with their family physicians or specialists.

# Cardiology

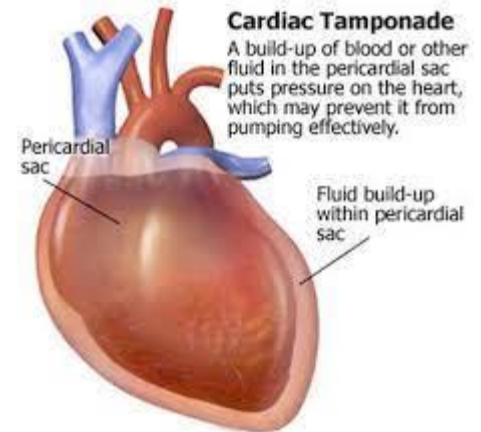
## Problems of the heart

### ▶ Inflammation

- ▶ Endocarditis – usually strep
- ▶ Myocarditis – can be related to Covid vaccination
- ▶ Pericarditis – usually benign and self-limiting

BUT >>>

- ▶ Cardiac tamponade

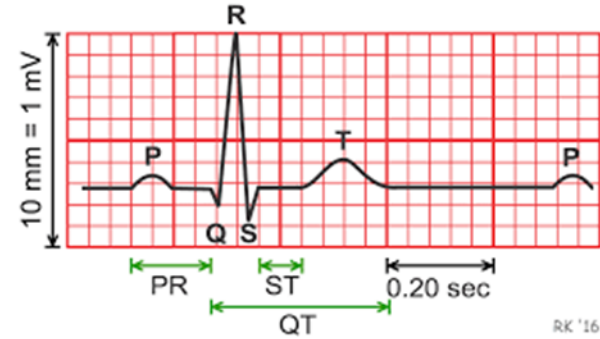


# Cardiology

Electrical = rhythm

Benign palpitations

Atrial fibrillation



# Cardiology

## Atrial fibrillation...

- ▶ **Why treat?**
- ▶ Treatment options
- ▶ Cardioversion
- ▶ ~~Medications~~
- ▶ Rate control -- Beta-blockers and digoxin
- ▶ Anticoagulation if CHADS<sub>2</sub> score is 1 for males and 2 for females

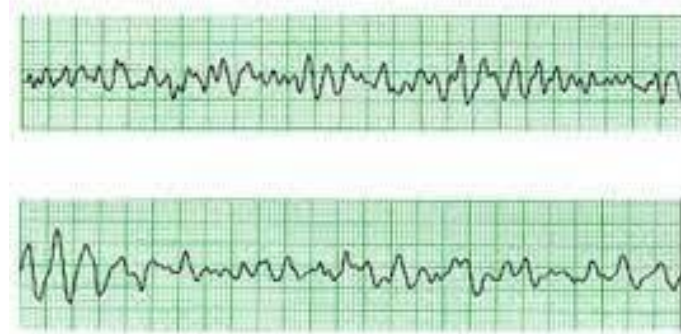
Original CHADS <sub>2</sub> Score		
<b>C</b>	Congestive Heart Failure	1
<b>H</b>	Hypertension (>140/90mmHg)	1
<b>A</b>	Age $\geq$ 75	1
<b>D</b>	Diabetes Mellitus	1
<b>S<sub>2</sub></b>	Prior TIA or stroke	2

# Cardiology

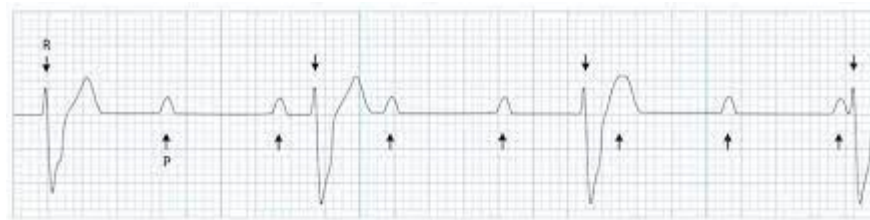
- ▶ Ventricular fibrillation



## Ventricular Fibrillation



- ▶ Heart block



- ▶ Vasovagal attacks (fainting)

# Cardiology

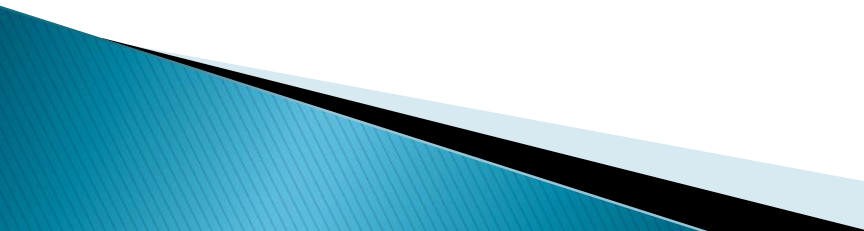
**Congestive Cardiac Failure** means the heart is pumping, but the amount of blood it can pump cannot meet the body's needs.

Some causes

- ▶ high blood pressure,
- ▶ coronary artery disease,
- ▶ heart attack,
- ▶ heart valve disease,
- ▶ arrhythmia.

# Cardiology

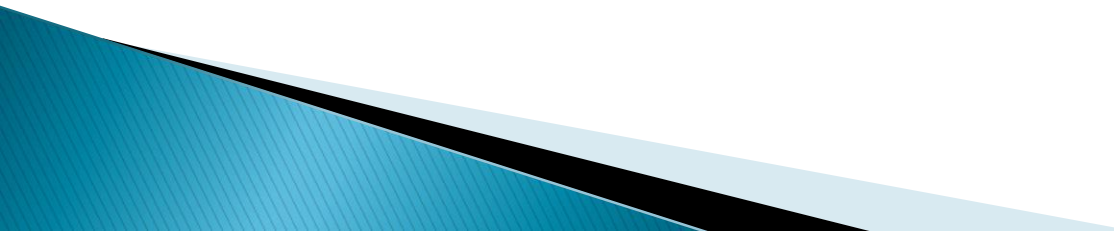
## Symptoms

- Shortness of breath with activity or when lying down.
  - Paroxysmal nocturnal dyspnea
  - Fatigue and weakness.
  - Swelling in the legs, ankles and feet.
  - Rapid or irregular heartbeat.
  - Reduced ability to exercise.
  - Persistent cough or wheezing with white or pink blood-tinged mucus.
  - Swelling of the abdomen
- 

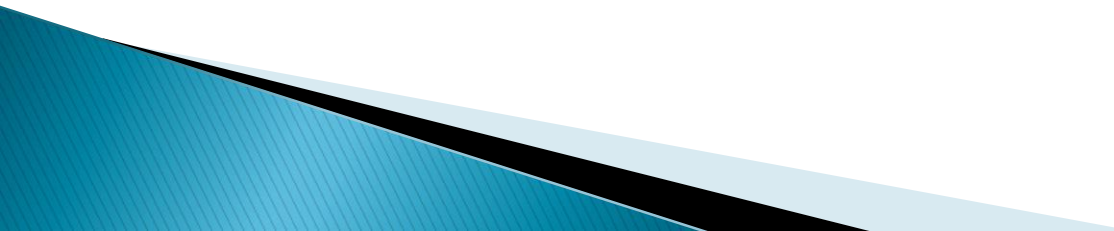


# Cardiology

## Treatments

- **Vasodilators** expand blood vessels, ease blood flow, and reduce blood pressure.
  - **Diuretics** correct fluid retention.
  - **Aldosterone inhibitors** help with fluid retention and improve chances of living longer.
  - **ACE inhibitors or ARB drugs** improve heart function and life expectancy.
- 

# Cardiology

- ▶ Digitalis glycosides strengthen the heart's contractions.
  - ▶ Anticoagulants or antiplatelets such as aspirin help prevent blood clots.
  - ▶ Beta-blockers improve heart function and chances of living longer.
  - ▶ Fluid restrictions (30ml per Kg)
  - ▶ Cardiac exercise programme
- 

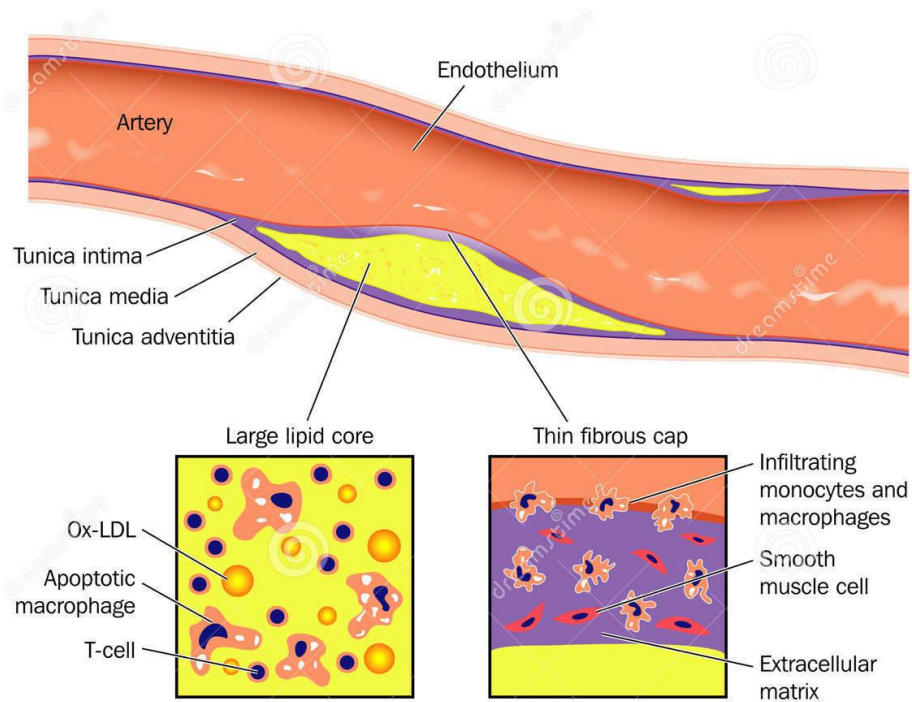
# Cardiology

## Problems caused by atherosclerosis...

Atherosclerosis causes two major types of problems.

It will cause obstruction to the flow of blood to the arteries and subsequently to the small blood vessels and tissues. This is a gradual process. Occasionally these plaques of cholesterol like substance will crack so that the blood flowing past detects it as an injury, and starts laying down blood clots. This will lead to an abrupt cessation of blood flow leading to a heart attack or stroke.

# Cardiology



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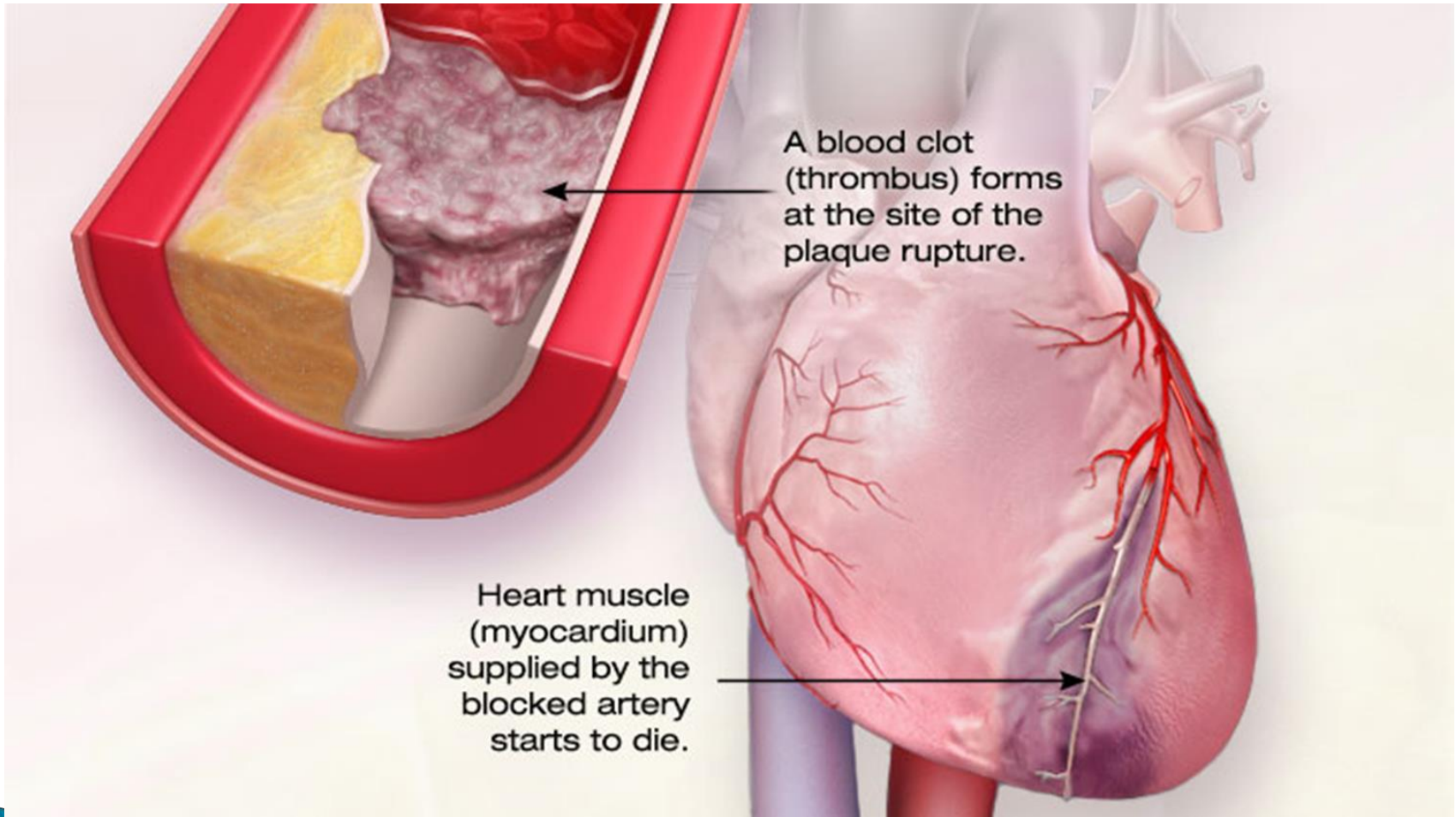
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# Cardiology



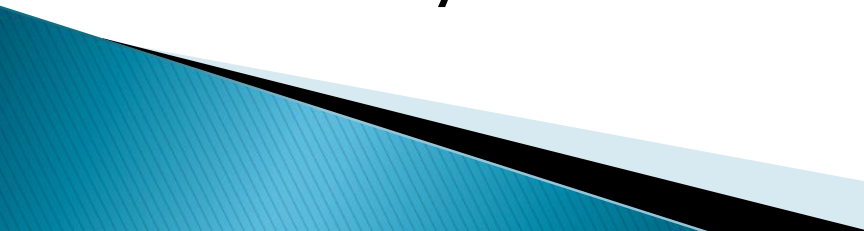
# Cardiology

- ▶ Arterial problems due to atheroma
  - Obstruction to the arteries to the brain
  - Obstruction to peripheral arteries
  - Obstruction to the arteries of the heart itself

The flow of fluid through a cylinder is a function of the fourth power **i.e.  $x^4$**

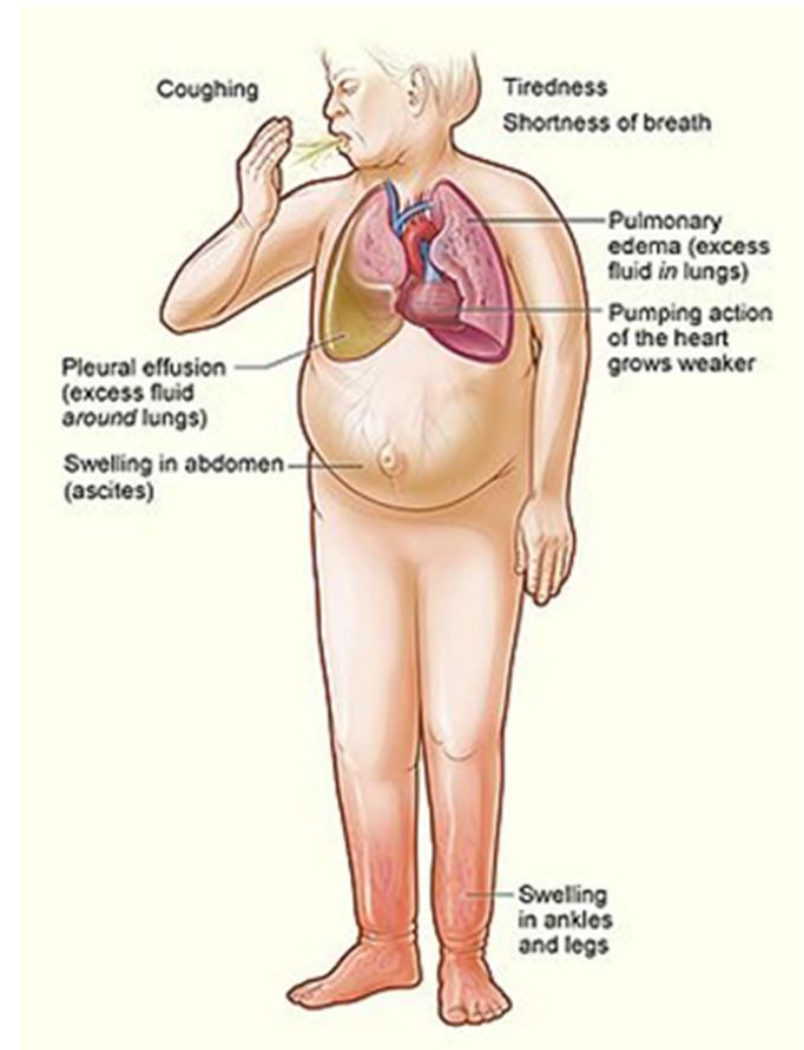
**Example - decreasing the obstruction in an artery by 5% will increase the flow by 41%**

# Cardiology

- ▶ What you **should** experience when you see a physician concerning cardiac symptoms...
  - ▶ History asking for chest pains, shortness of breath with activity and/or lying flat and recent weight gain
  - ▶ Record vital signs – temperature, height, weight, pulse rate and rhythm, blood pressure.
  - ▶ Palpate the heart looking for the Apex beat and any "cardiac heave".
- 

# Cardiology

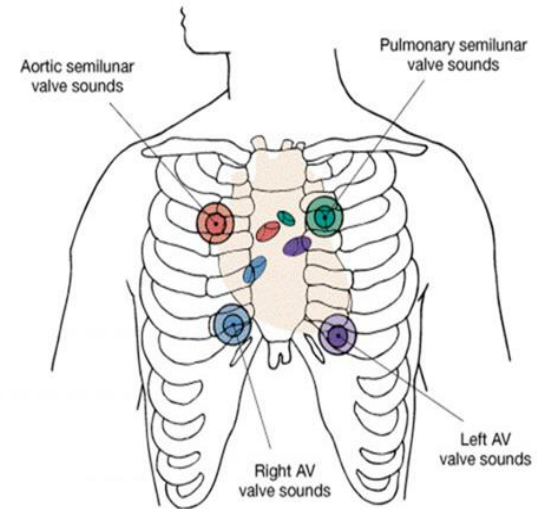
- ▶ Take two steps back and observe the entire patient, then check for any signs of shortness of breath, swelling of the ankles, cyanosis





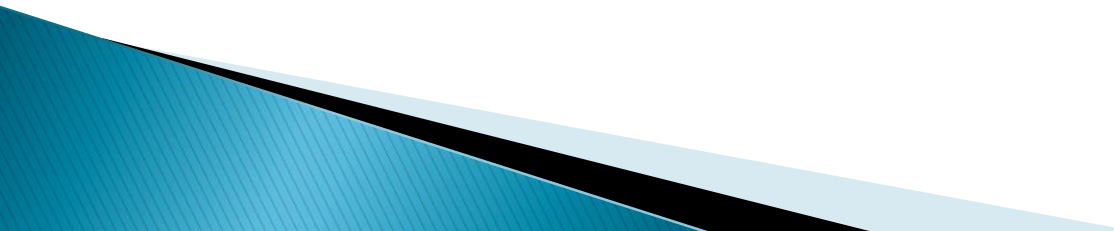
# Cardiology

- ▶ Listen to the heart where the leaking or stenotic valves can be heard.
- ▶ Listen to the lungs, especially the lower, listening for signs of fluid accumulation (crepitations)
- ▶ With the patient recumbent at 45° check for distended veins in the neck.
- ▶ Check the peripheral arteries for pulses, and also the nature of the peripheral blood vessels



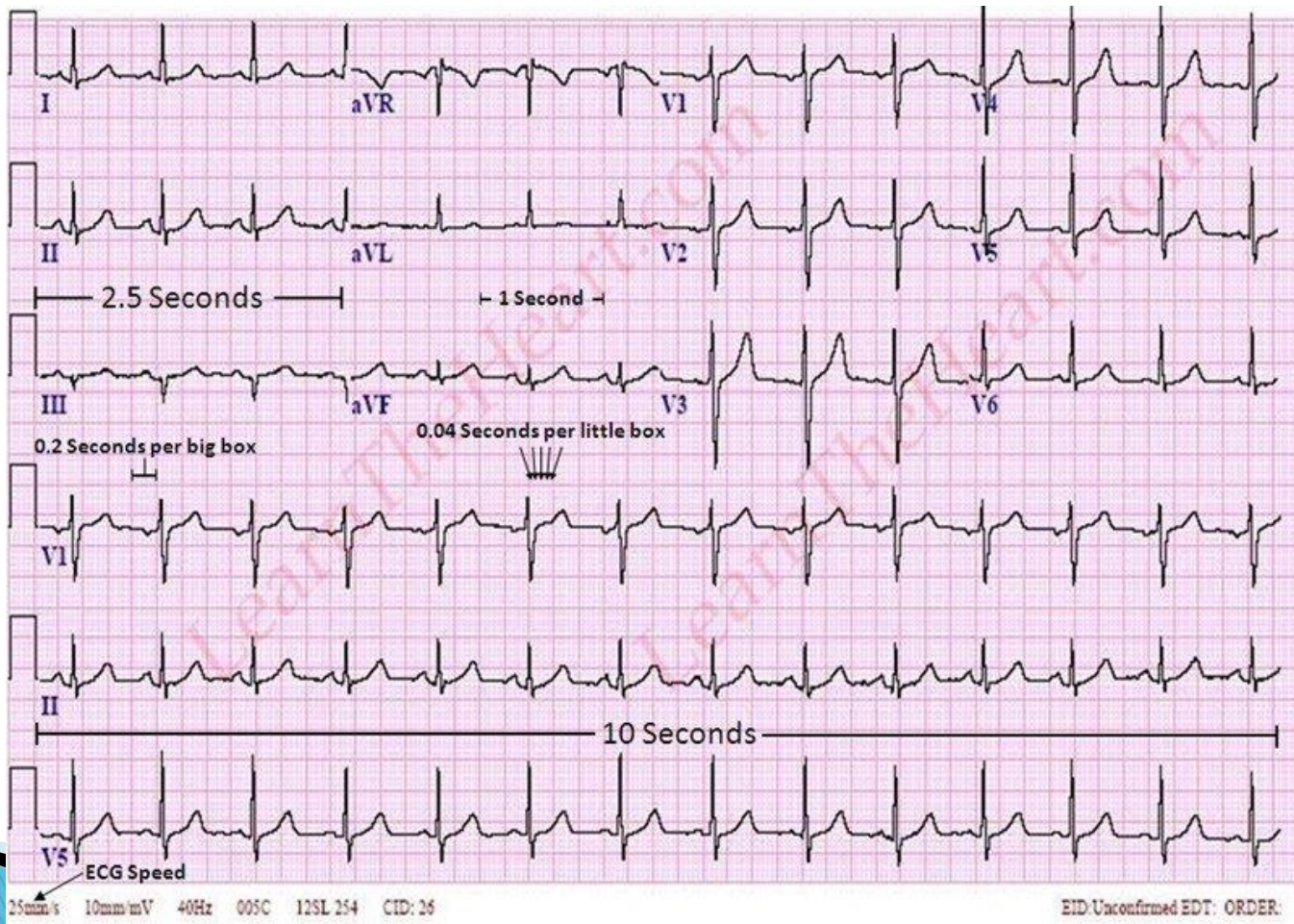
# Cardiology

## Investigations

- ▶ Complete blood count, kidney functions, glucose level, urinalysis, cholesterol
  - ▶ Electrocardiogram
  - ▶ Echocardiogram
  - ▶ Nuclear scan or SPECT
  - ▶ Ejection fraction
  - ▶ Treadmill stress test
  - ▶ CT Angiogram
  - ▶ Coronary angiogram
- 

# Cardiology

## ▶ Electrocardiogram



# Cardiology

- ▶ Acute Myocardial infarction



# Cardiology

## Relatively new and useful additional blood tests

- **B-type natriuretic peptide (BNP)**

This peptide is secreted by a stressed heart. It is comfortably specific. Its main value is that when the patient complains of shortness of breath, this will indicate whether it is due to the heart failure or some other problem such as anemia or respiratory problems.
- **Troponin T**

This compound is released into the blood in the event of a sudden loss of blood supply to the heart. It will give a ready answer when a patient is experiencing chest pain. Being able to confirm or comfortably rule out an acute myocardial infarction is a great step forward.
- **D-dimer test**

This test will rapidly indicate whether chest pain or shortness of breath is due to a pulmonary embolism – that is a blood clot travelling in the venous system. A negative test can avoid more elaborate (and expensive) investigations.

# Cardiology

## Ejection fraction

This measures the amount of blood which is expelled from the ventricles (almost always a left ventricle) at each systolic movement.

Normal range is somewhat above 50 – 70% in healthy adults

Borderline range is 41 – 50%

Cardiac failure this can drop below 40%

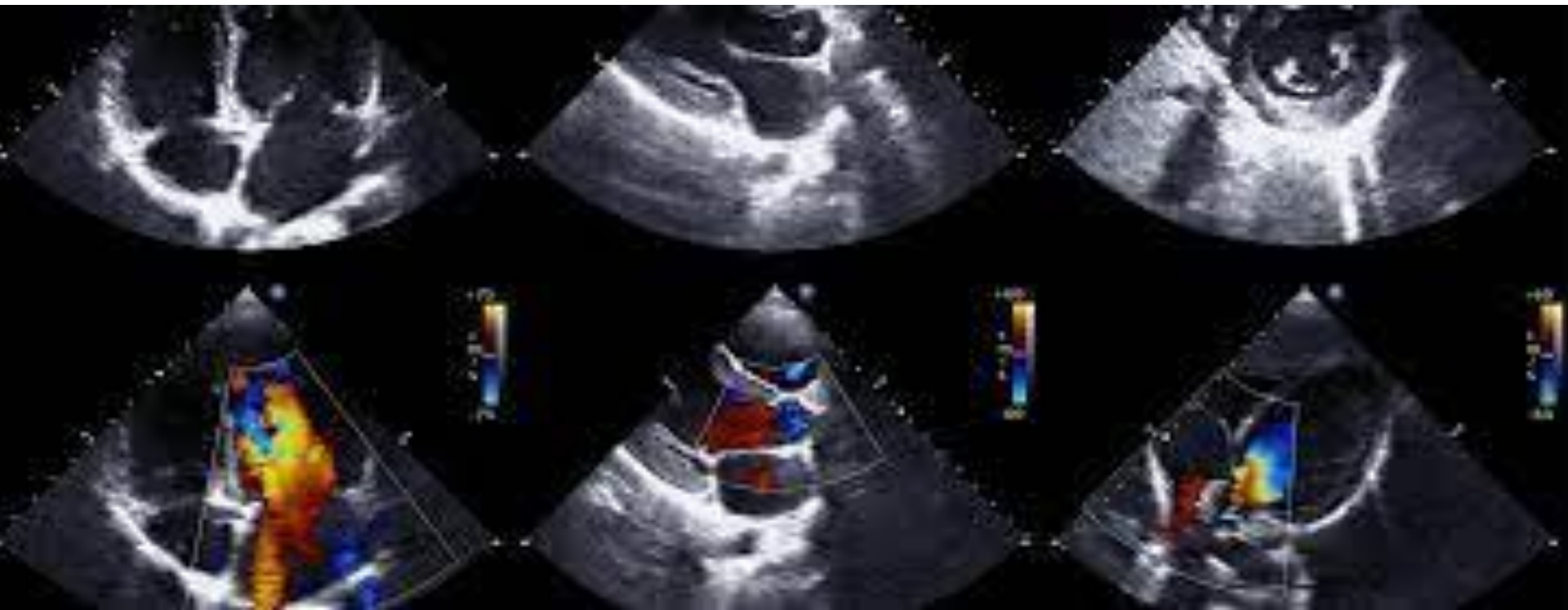
It can be estimated by the echocardiogram or with a nuclear medicine scan. It is also noted incidentally during more elaborate cardiac imaging.

# Cardiology

- ▶ Echocardiogram



# Cardiology





# Cardiology

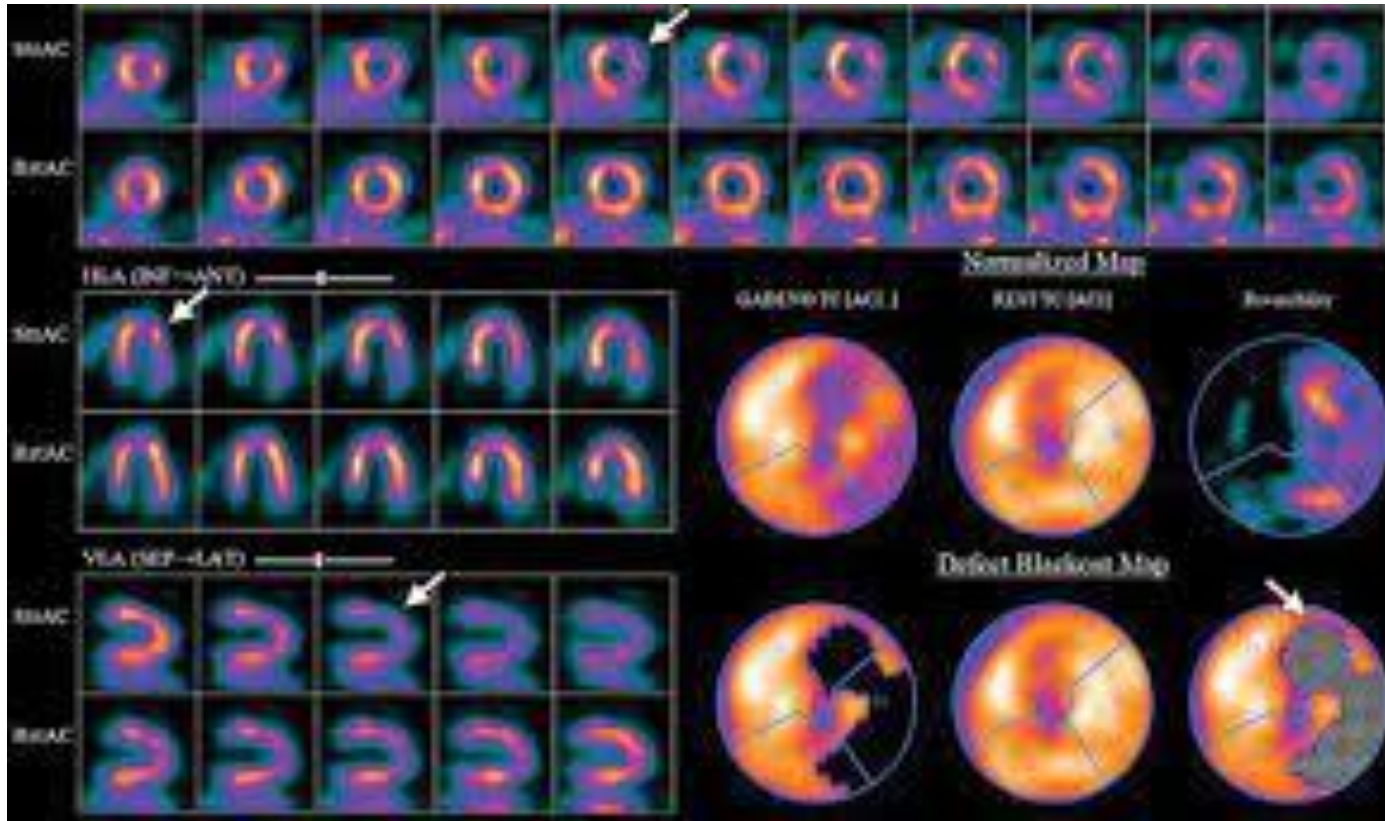
Nuclear medicine scan or SPECT ( single-Photon Emission Computerized Tomography)

This is a noninvasive way of checking the circulation of the heart. A radioisotope is injected intravenously and a camera modified to take gamma ray photographs will scan the heart after a short time and again several hours later.

This can be combined with a CT type scan (tomography) giving a very high quality imaging sometimes with three dimensions.



# Cardiology

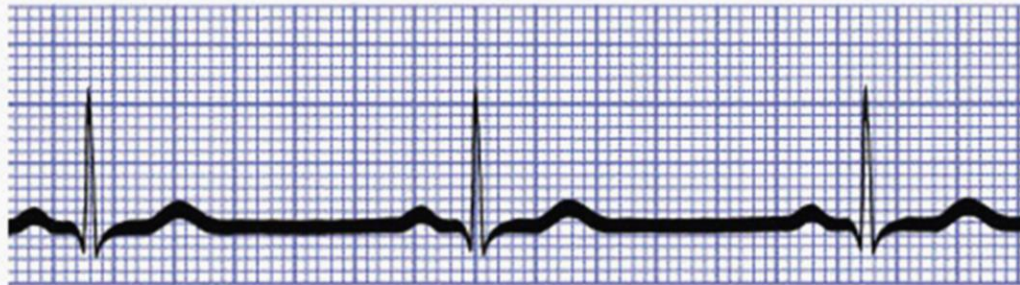
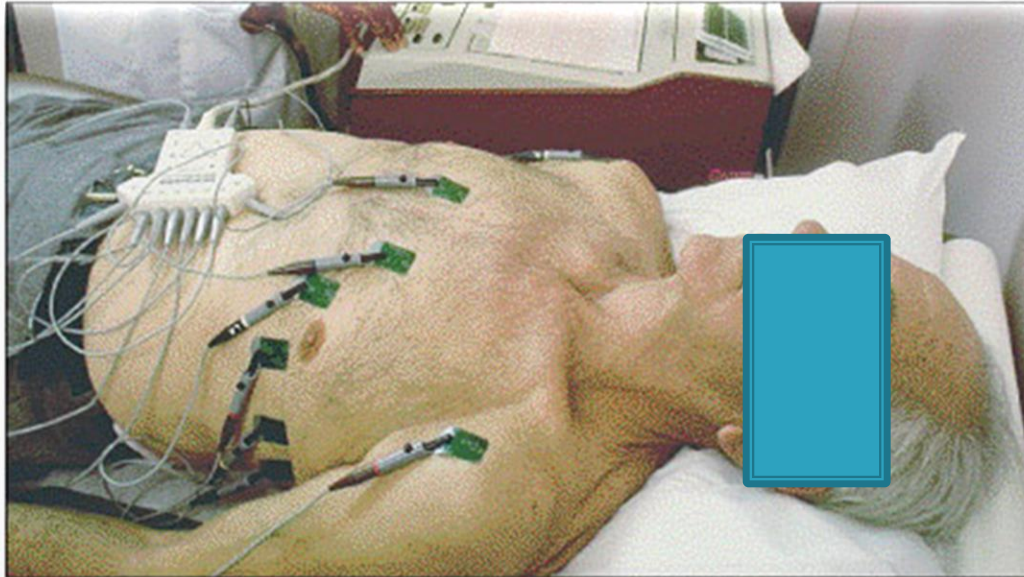


# Cardiology

## Exercise stress test

- This test is preceded with an electrocardiogram. The patient is then exercised, usually on a treadmill, which is set at a definite speed and elevation and is increased under a Bruce protocol.
- The test is continued until either 80% of the maximum heart rate ( $220 - \text{age}$ ) is reached, the patient experiences chest pain, or the patient becomes distressed due to weakness or shortness of breath.
- Throughout the test the pulse rate and blood pressure are monitored. After the test the pulse rate is observed to see how quickly it settles – an indication of general fitness.
- The ECG is examined and any changes in the ST segment indicate that there is a problem with the blood supply to the heart.
- This, in itself, is a non-specific test, but a positive test certainly mandates further investigations.

# Cardiology



EKG rhythm strip

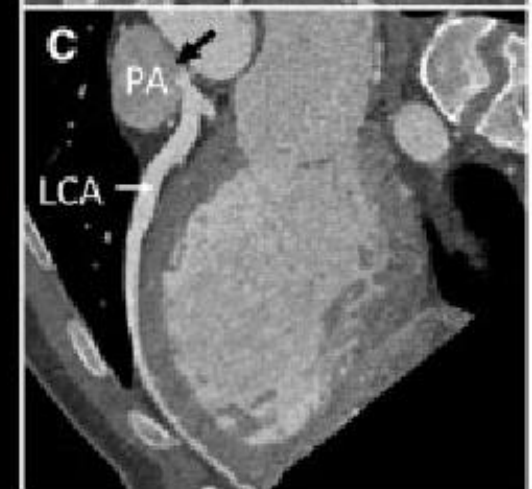
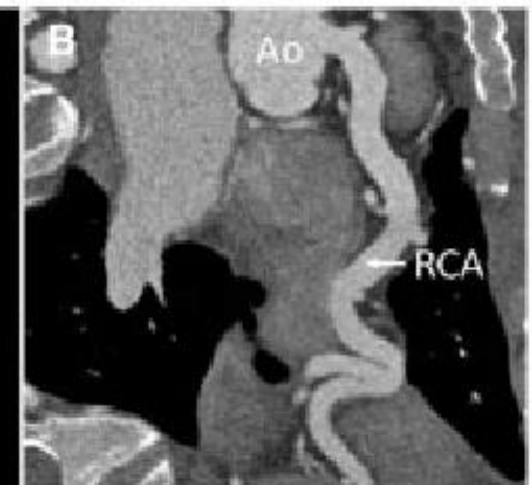
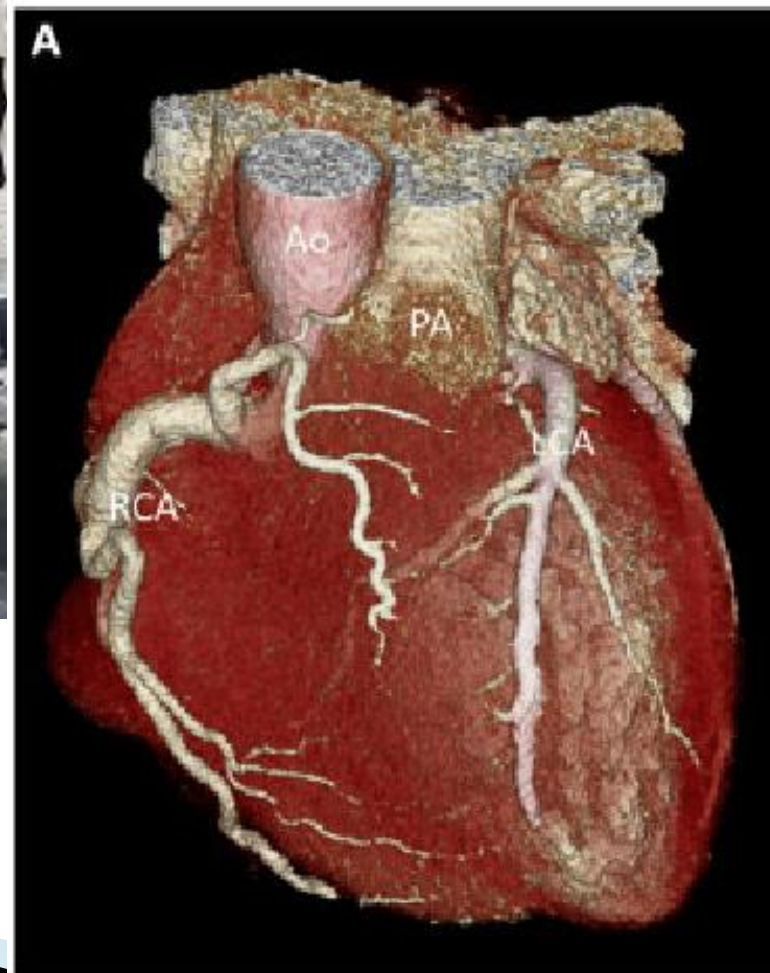
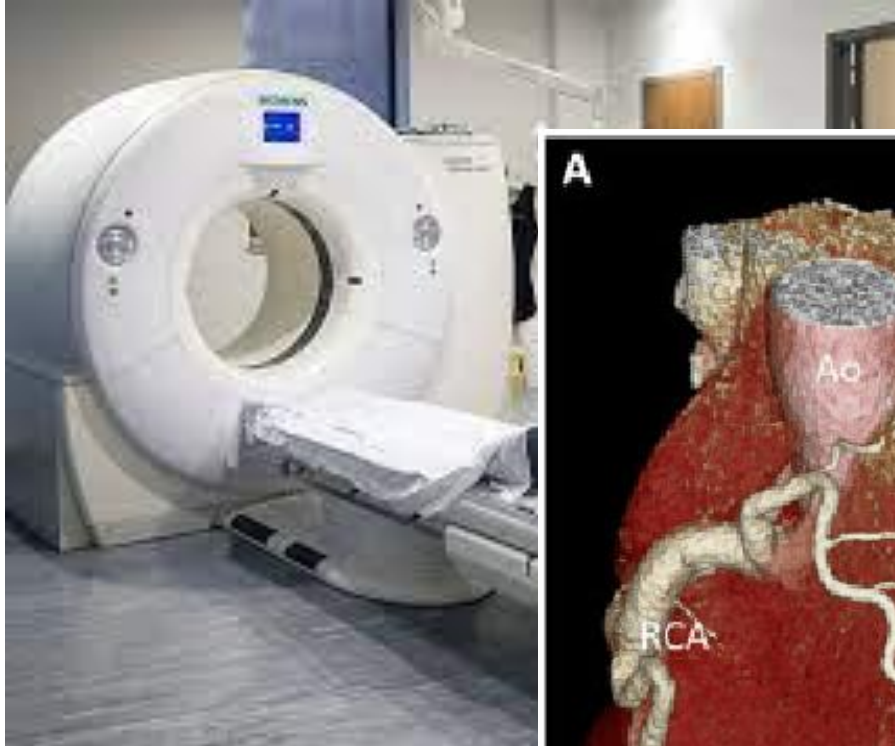
# Cardiology

## CT coronary angiogram

In this test a small dose of radio-opaque dye is injected into a vein. A CT x-ray is then taken. Because of the dye in the coronary arteries, after some computer manipulations, these will stand out on the CT scan. Any areas of stenosis of the coronary arteries or areas of extensive atherosclerosis will show up on this type of scan.

The advantage of it is that it is noninvasive. The downside is that the imaging will not be quite as clear as a regular angiogram, and if a narrowed artery is found it cannot be treated by this exam.

# CT angiogram

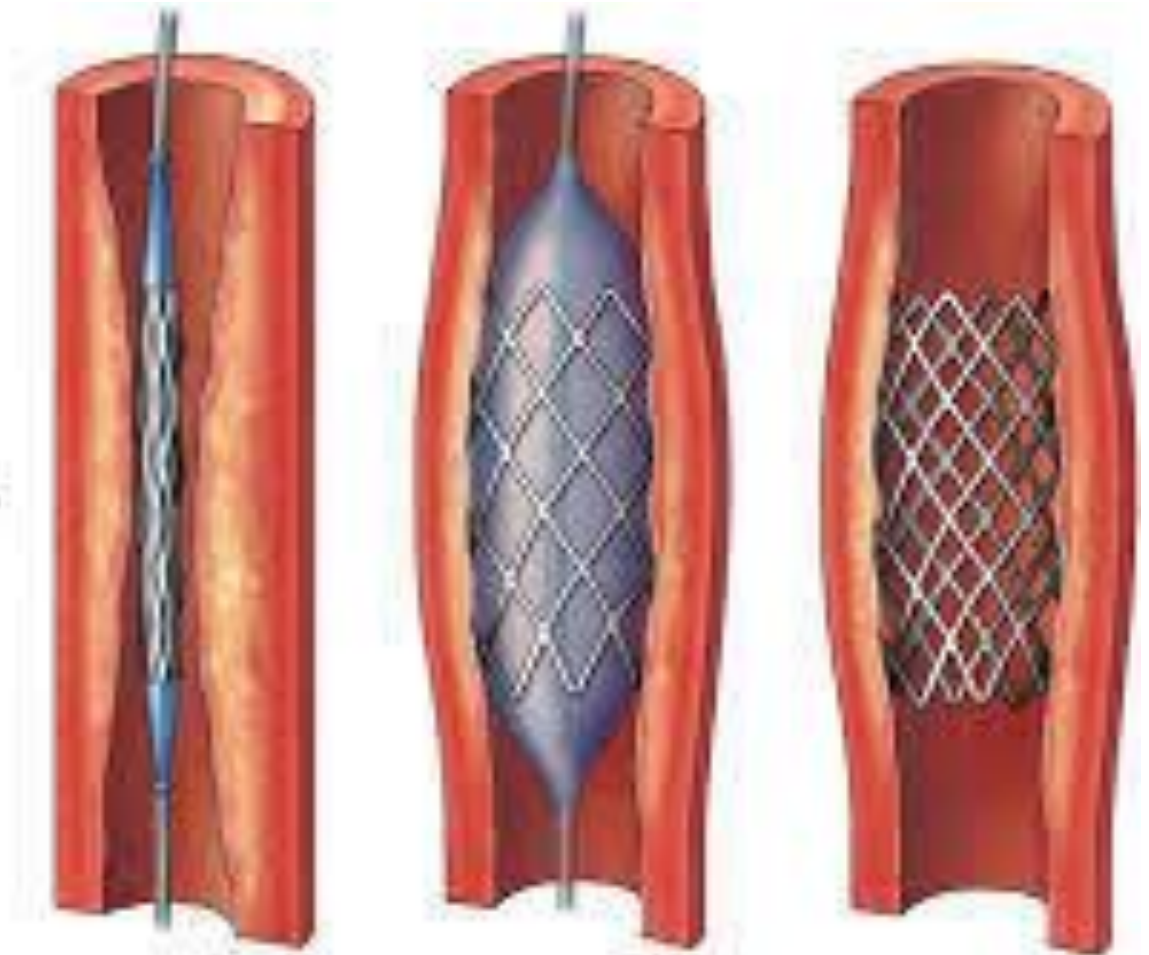
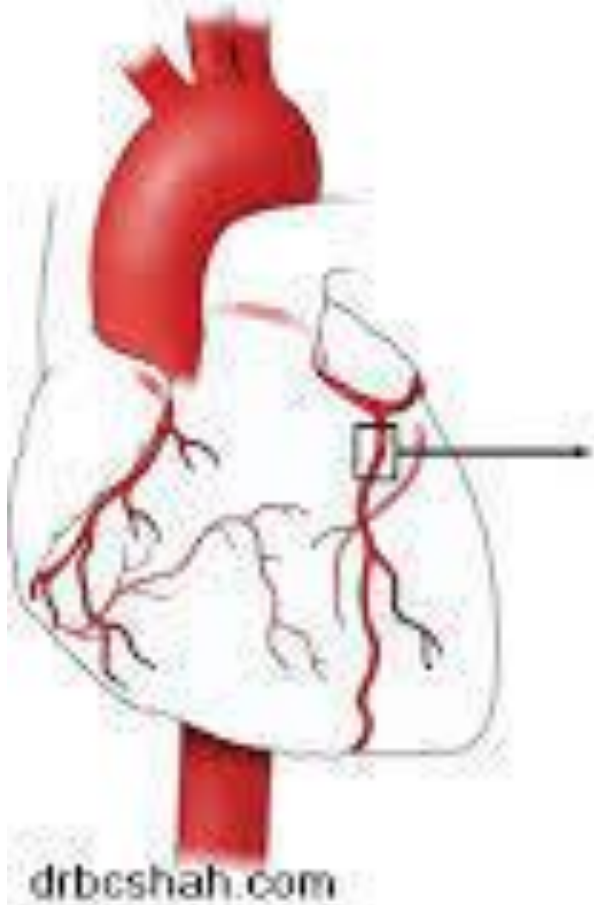


# Cardiology

## Coronary Angiogram

This is the gold standard. This is where a radiopaque dye is injected through a catheter into the coronary arteries. X-rays are taken. If an area of narrowing is identified then it can be stretched open with the balloon on the catheter or more likely a stent will be inserted into the artery.

# Cardiology





# Cardiology



**Plaque Before  
Treatment**



**Stent  
Procedure**



**Result After Stent  
Procedure**

# Cardiology

## Cholesterol!

- ▶ This vilified substance is found widely in the body. It is essential for the building of cell membranes and many hormones as well as helping the liver to digest our foods.
- ▶ A certain amount of cholesterol is made by the body itself, and not just taken in in the form of diet, mostly from fats which are solid at room temperature – that is to say saturated fats.
- ▶ People with elevated cholesterol are found to be more susceptible to cardiovascular events. A long-standing source of argument is whether this association is found to be coincidental or cause-and-effect.
- ▶ A group of medications has become available over the past 30 or so years which reduce the level of cholesterol measurable in the blood. These are the statins. They do reduce the incidence of heart attack, stroke and death

# Cardiology

## Statin Medications

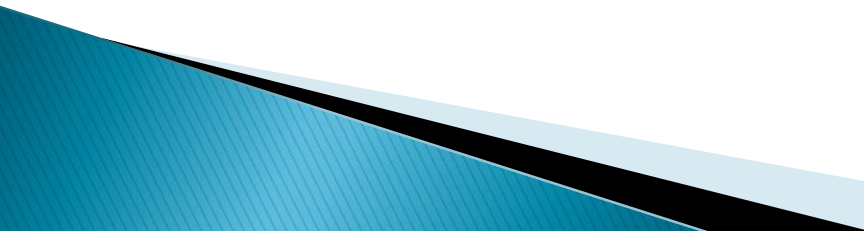
The question arises is whether these, by reducing the measured cholesterol, are directly responsible for reducing the heart attacks and strokes.

It is my opinion that these medications have a definite anti-inflammatory stabilising effect on the endothelium of the arteries and arteriols, and it is this, rather than the numerical reduction of cholesterol, that leads to their benefit.


# Cardiology

- ▶ At around about the age of 50 – 60 it would be reasonable to take a cholesterol estimate. The results could come back at three levels.
- ▶ **Low** – no further intervention required. The cholesterol is unlikely to change in the next ten or twenty years.
- ▶ **Medium** – care should be taken to bear in mind the suggestions in the last slide of this presentation.
- ▶ **High** – about 6 or greater. Follow assiduously the recommendations on the ultimate slides. Lose weight or certainly gain no more.
- ▶ Who should take a statin medication and at what dose?

# Cardiology


- ▶ One school of thought is that the starting medication can be increased gradually until the LDL-cholesterol (thought to be the "bad" one) is reduced to 2.0 or less.
  - ▶ This requires frequent and not inexpensive blood tests.
  - ▶ A logical alternative is that a healthy low risk asymptomatic individual requires no statin medication.
  - ▶ A fit person with some concern such as a strong family history or diabetes should be treated with a lowish-dose statin medication
  - ▶ A high risk patient with a strong family history, overweight, smoker and who never exercises should be treated with as high a dose of statin as can be tolerated.
- 

# Cardiology

- ▶ **HOWEVER....**
  - ▶ There is coming online some more completely innovative medications to reduce cholesterol level and providing some convincing cardiac/stroke benefits.
  - ▶ These are expensive and need to be given by injections either every two weeks or once every six months.
  - ▶ It would be reasonable – no, essential – to be seen at a lipid clinic. These medications are revolutionary and I feel that a specialist knowledge would be safest, at least for the next few years.
  - ▶ The names are Nexletol and Nexlizet. I mention these names so that you can keep alert, and I think the literature will have quite a bit of information about these.
- 

# Cardiology

What to do to try to avoid cardiovascular disease...

- Quit smoking
  - Exercise regularly – attempt 6000 steps a day including a 1 hour workout 3 times a week
  - A relatively low fat, high-fibre diet
  - Try to gain no more weight
  - 2 alcoholic drinks or fewer in a day
  - Get good quality sleep – even if it means separate bedrooms
  - Check your own blood pressure every six months or so
  - Explore your lifestyle for areas where stress can be reduced
- 

# Cardiology

**Questions or  
discussions?**

