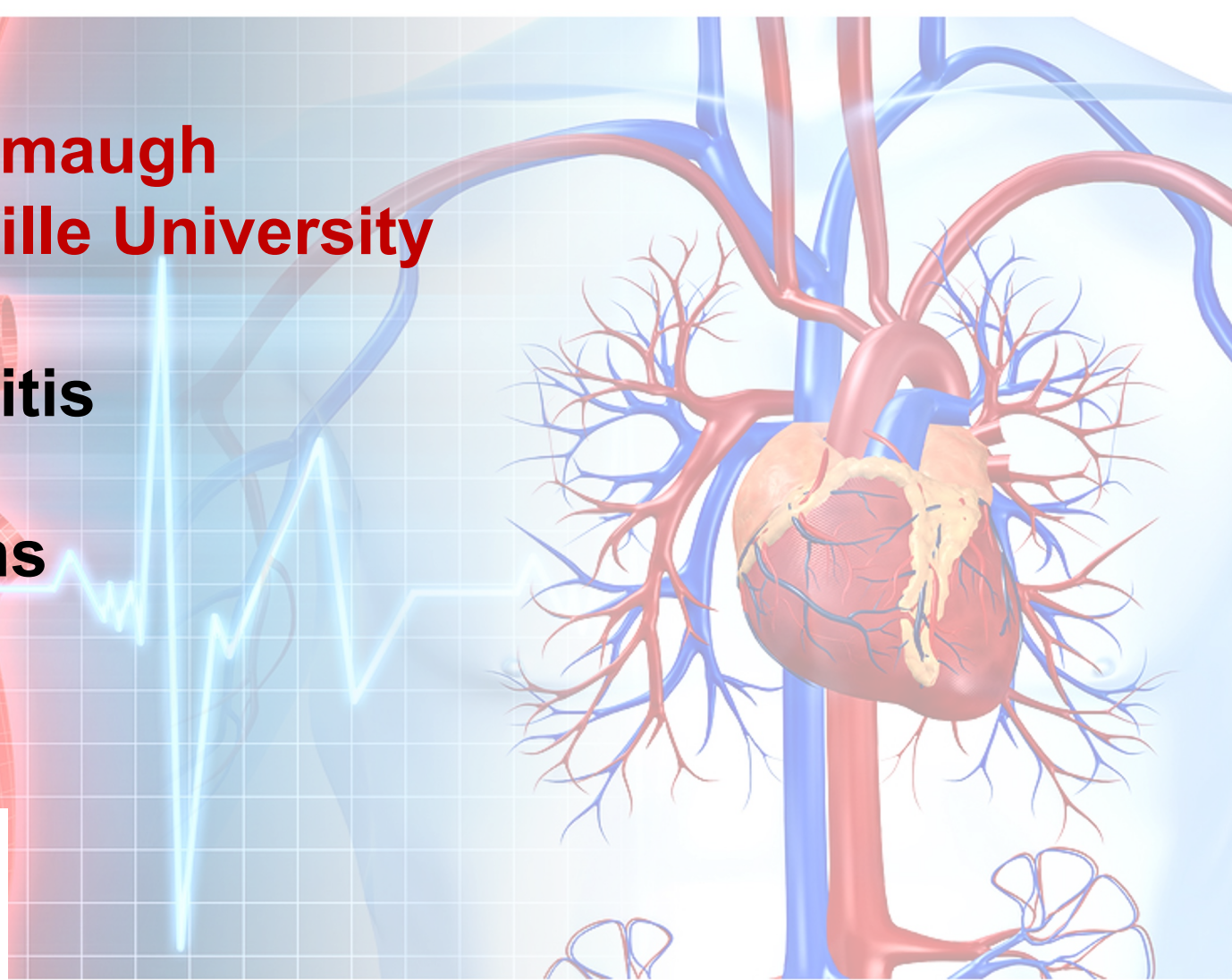
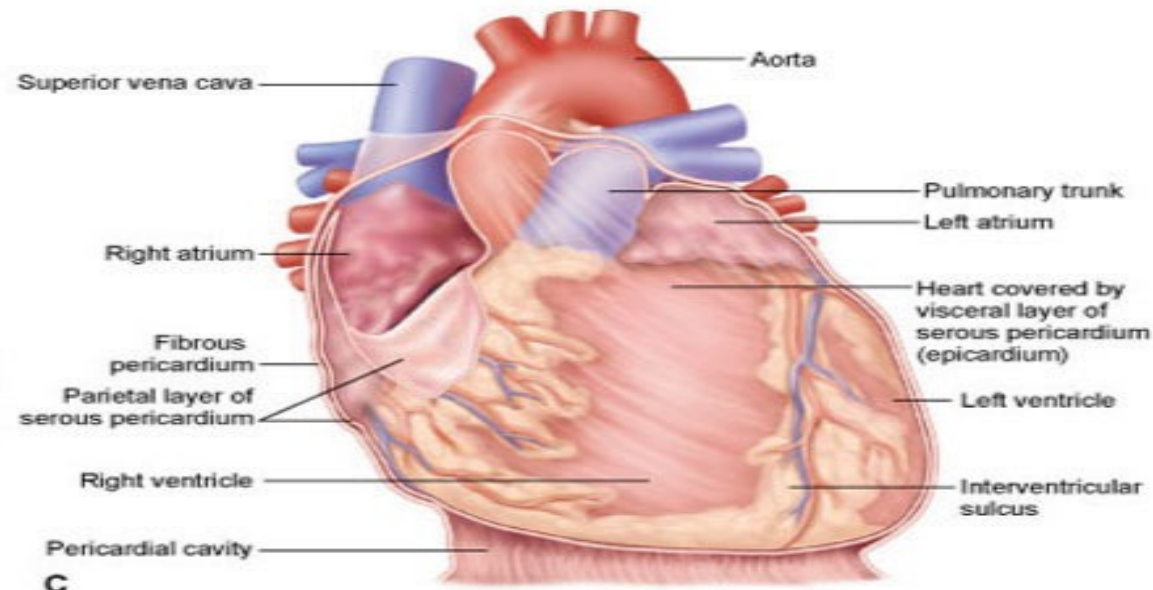
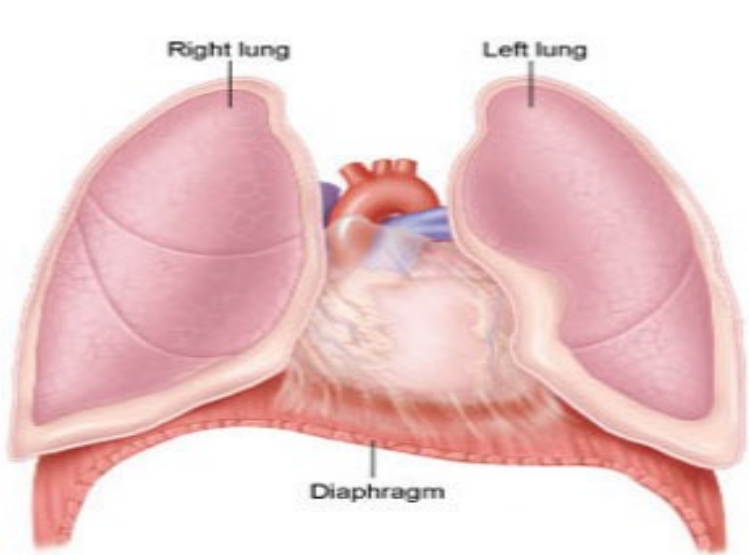
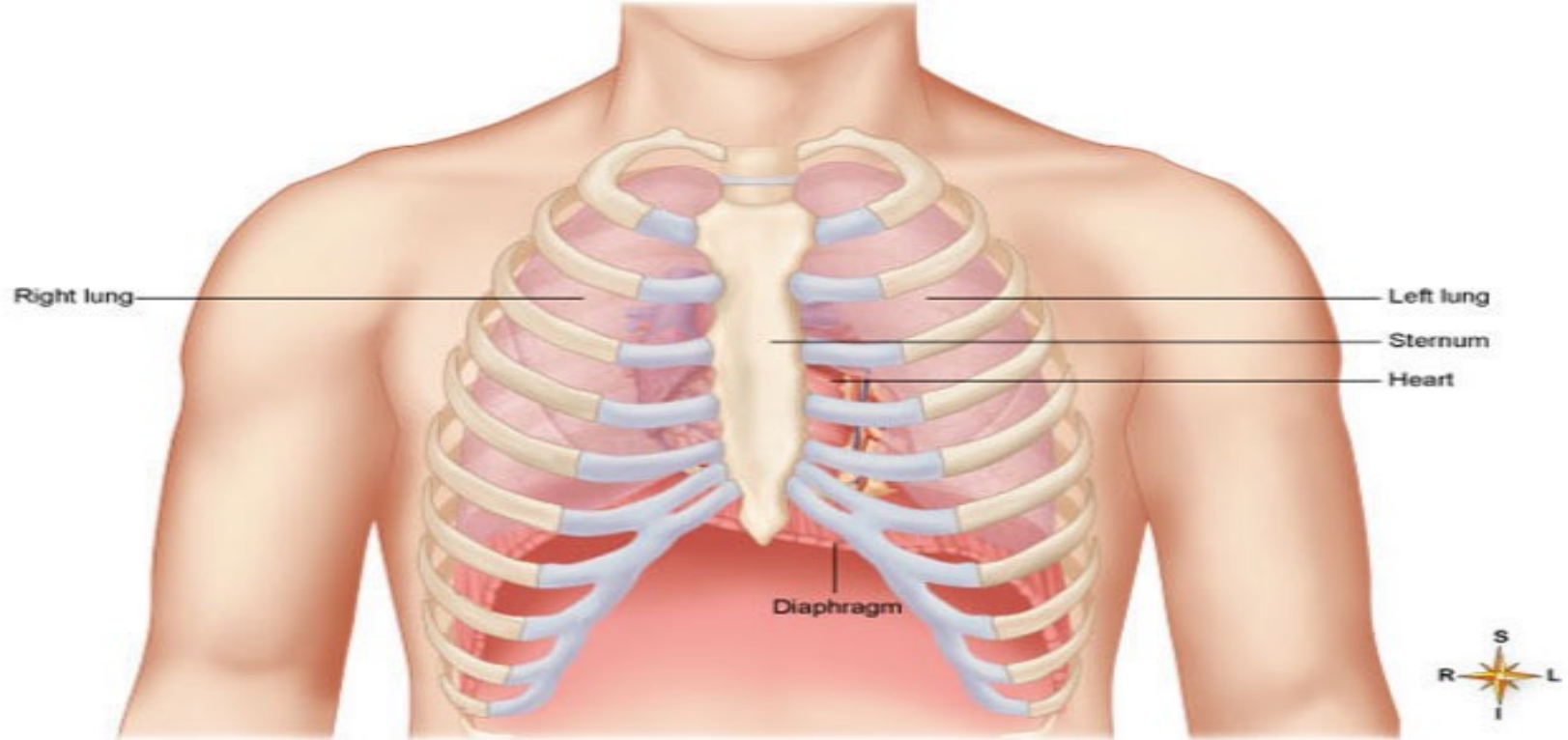


Dr. Gary Mumaugh Campbellsville University

- **Pericarditis**
- **Valves**
- **Infections**

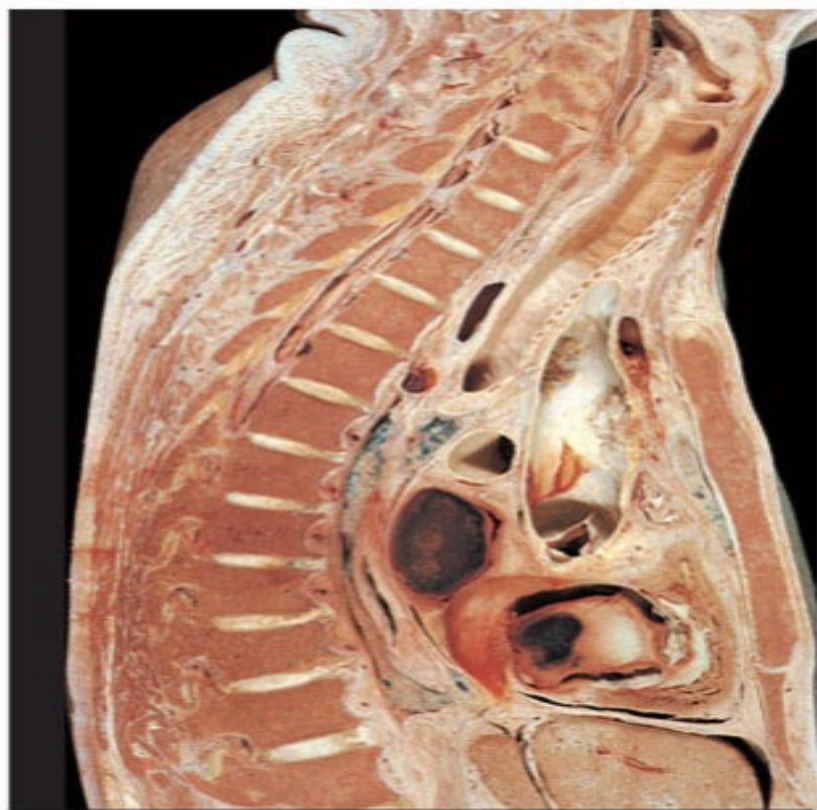
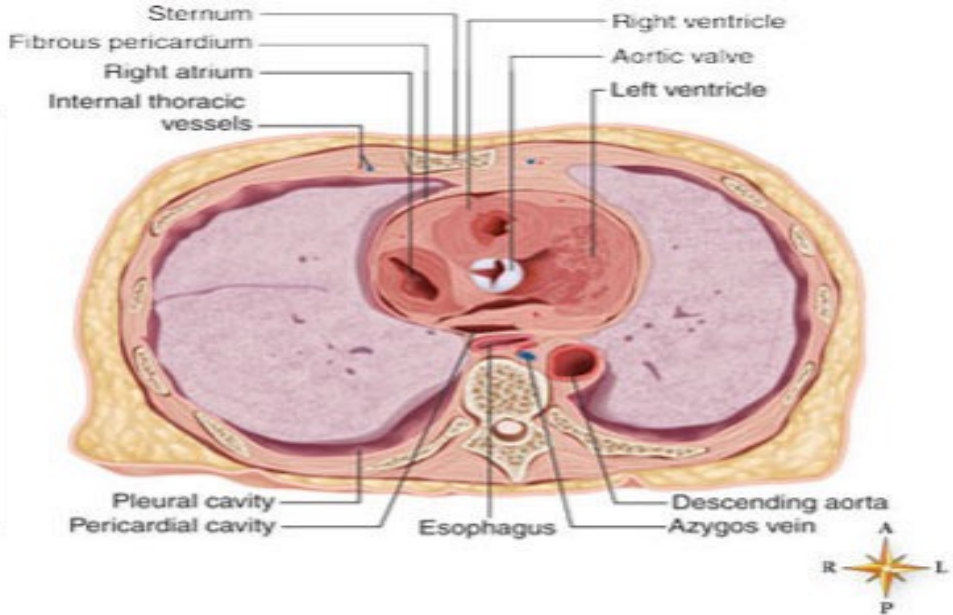


Cardiac Pathology 1

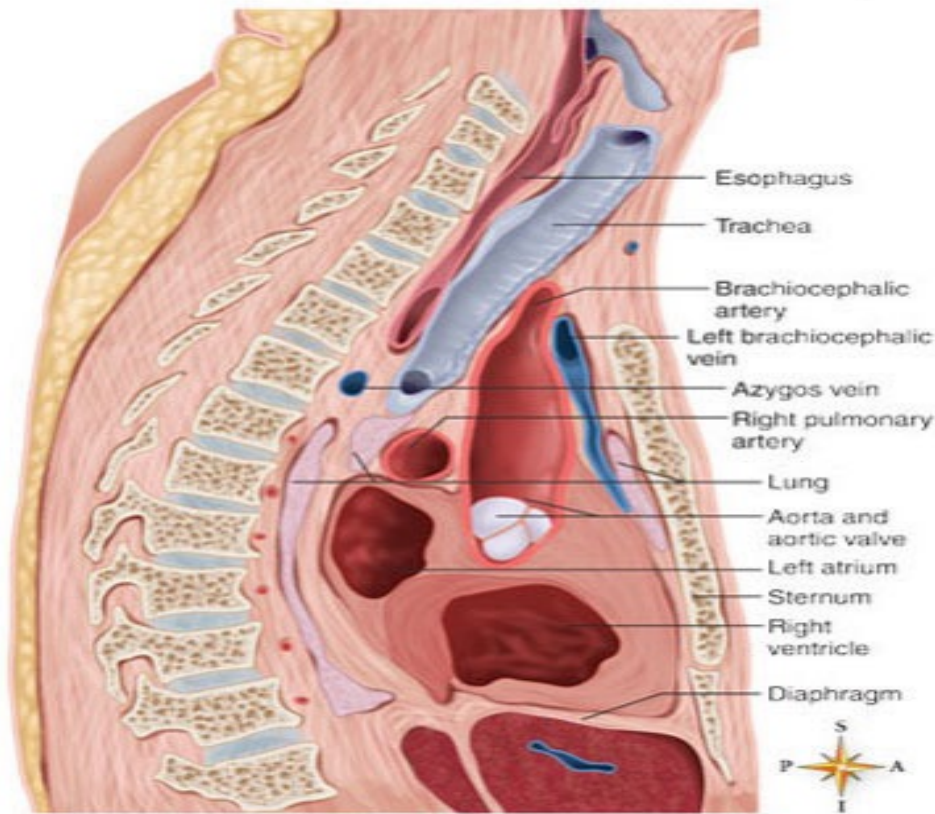




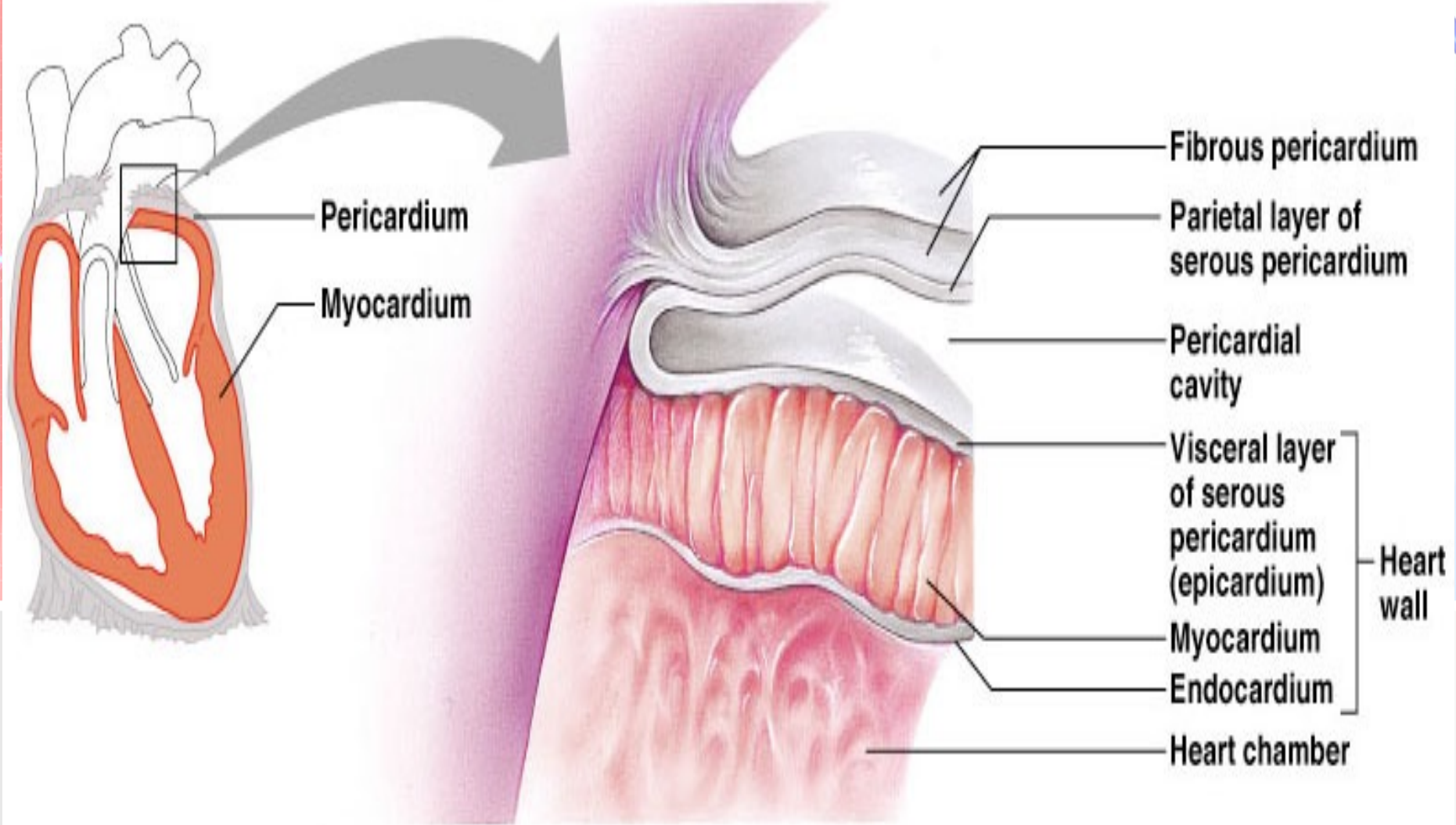
D



E



Pericardial Layers of the Heart

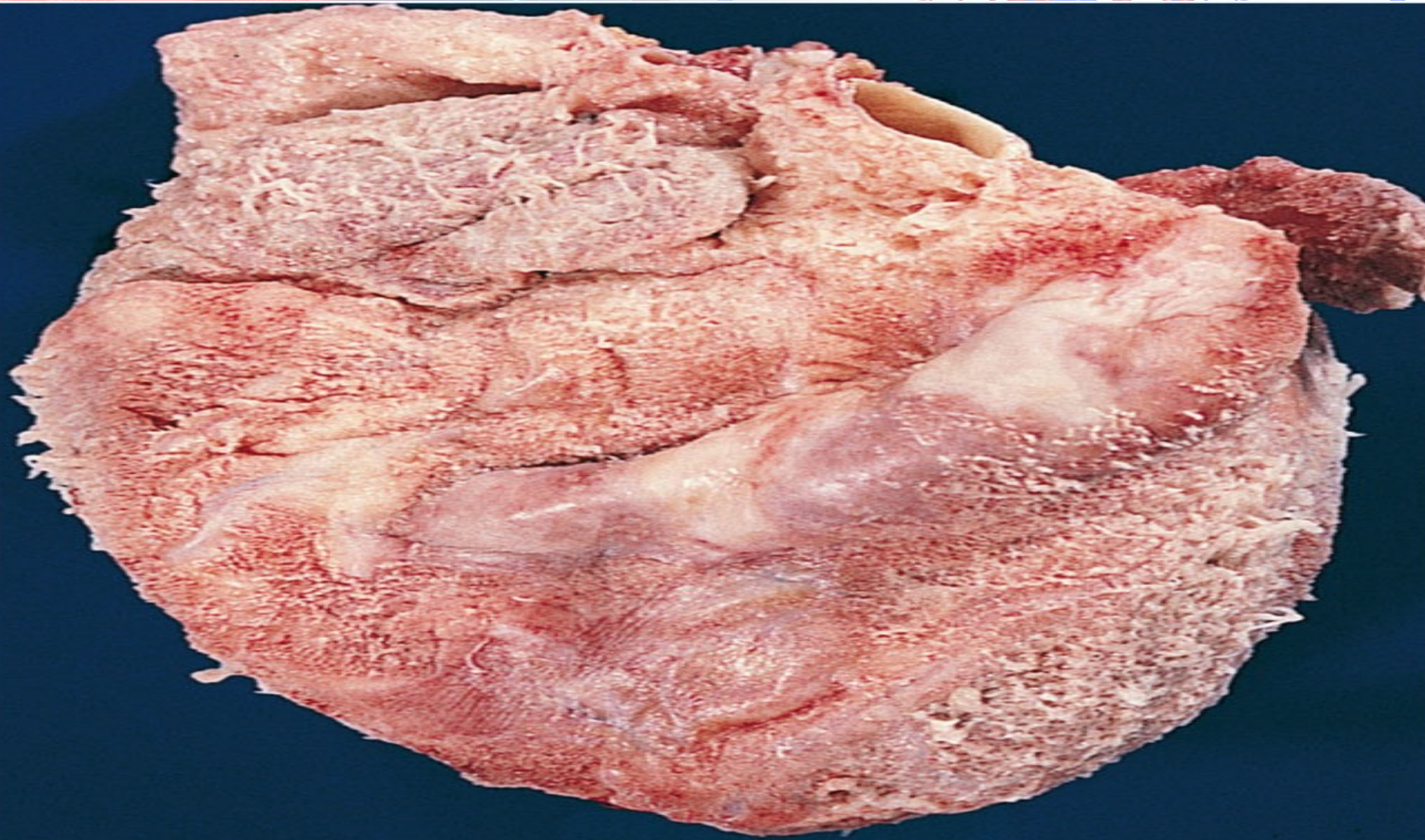


Pericarditis – Inflammation of the Pericardium



- The serous membrane is roughened up
 - When the heart beats, it rubs against the pericardial sac, creating a “grating” sound
 - Characterized by deep pain
 - In severe cases a large amount of inflammatory fluid seeps into the pericardial cavity causing a compression when the heart beats
- Cardiac Tamponade

Pericarditis



Pericardial Diseases



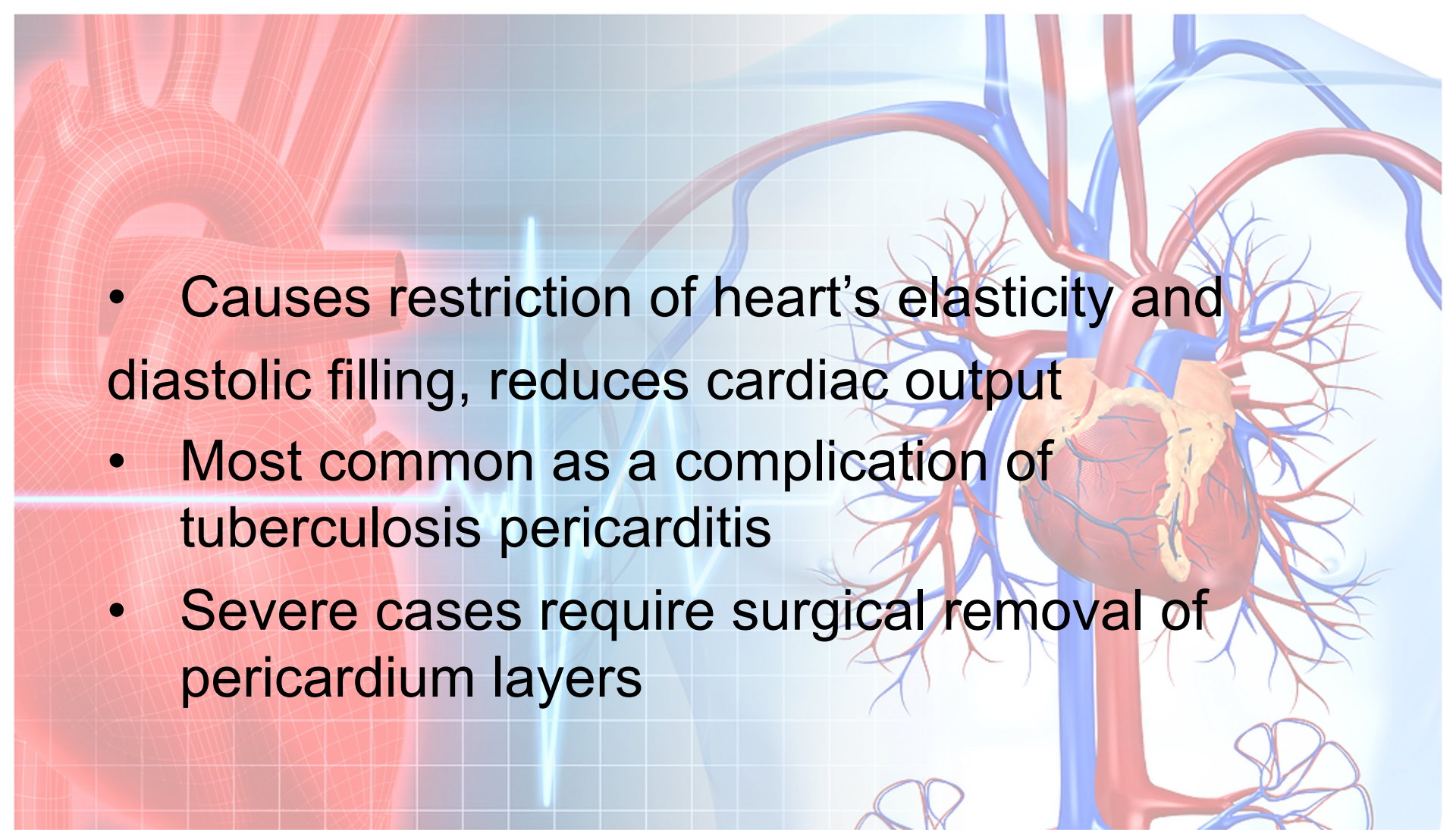
Pericarditis - Inflammation of the pericardium, often due to infection

- **Radiation-induced pericarditis** – develops after prolonged radiotherapy for Hodgkin's, lymphoma, or breast cancer
- **Acute Pericarditis**- nonspecific inflammatory response to injury
 - Fibrin is often found in the pericardial fluid - often a sign of extent of disease (serous, serofibrinous, or fibrinous)

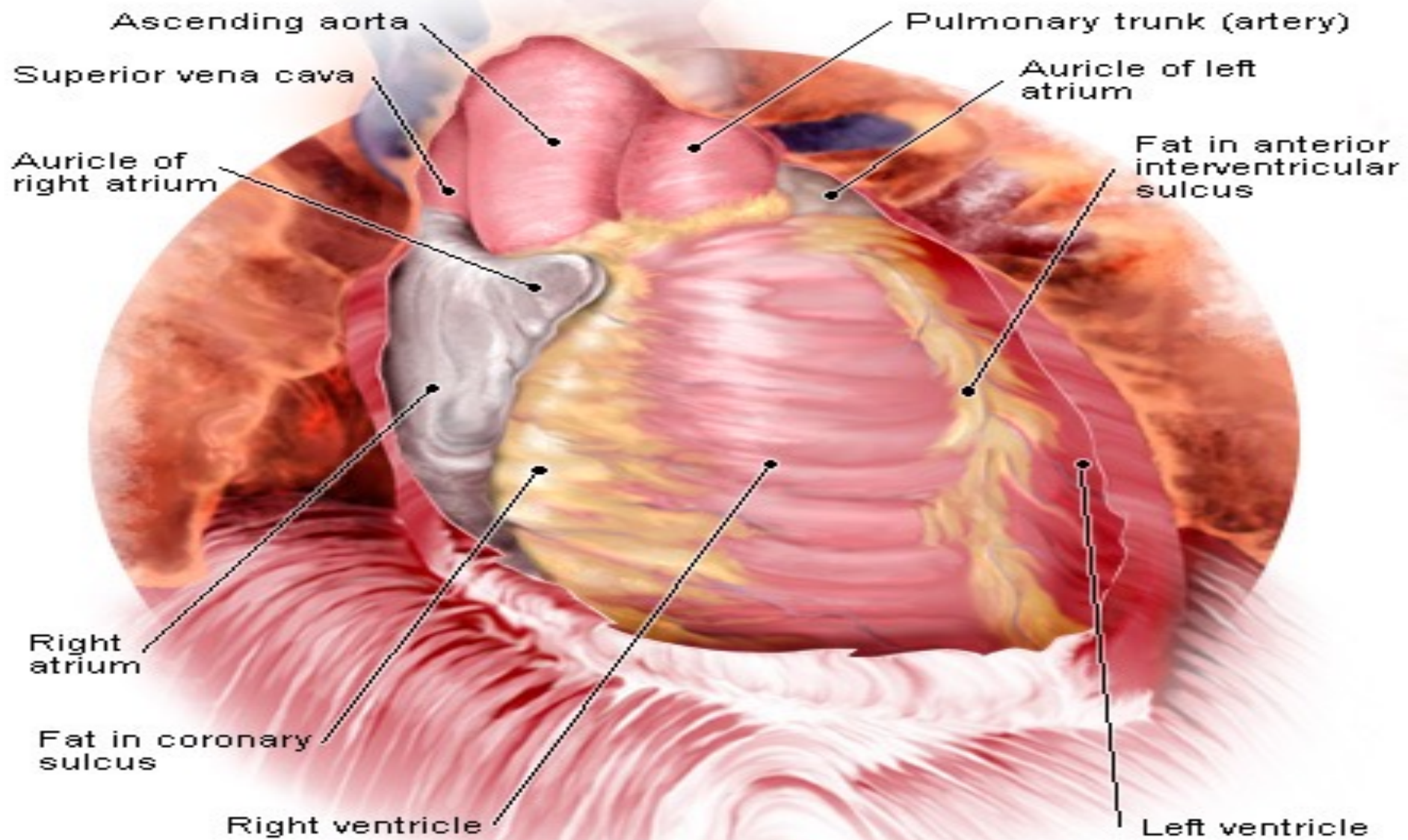


Chronic Pericarditis - arises as a complication of healing

- **Chronic constrictive pericarditis** - excess fibrosis may produce diffusely and densely scarred pericardial sac
 - Characterized by shell encasing the heart.
 - 50% of cases result in calcified pericardium where heart is encased in a “mold.”

- 
- Causes restriction of heart's elasticity and diastolic filling, reduces cardiac output
 - Most common as a complication of tuberculosis pericarditis
 - Severe cases require surgical removal of pericardium layers

Heart in the Pericardial Sac

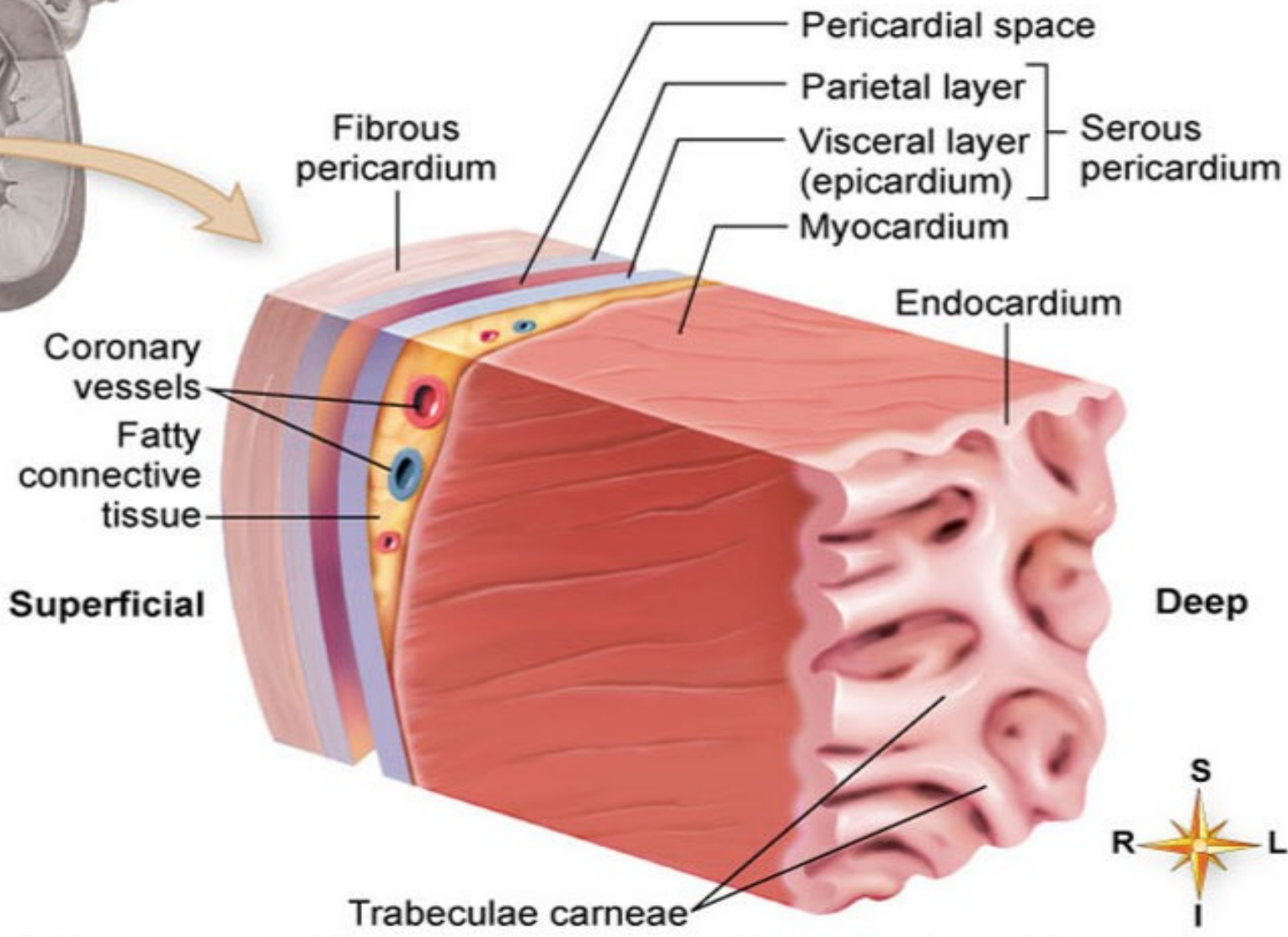
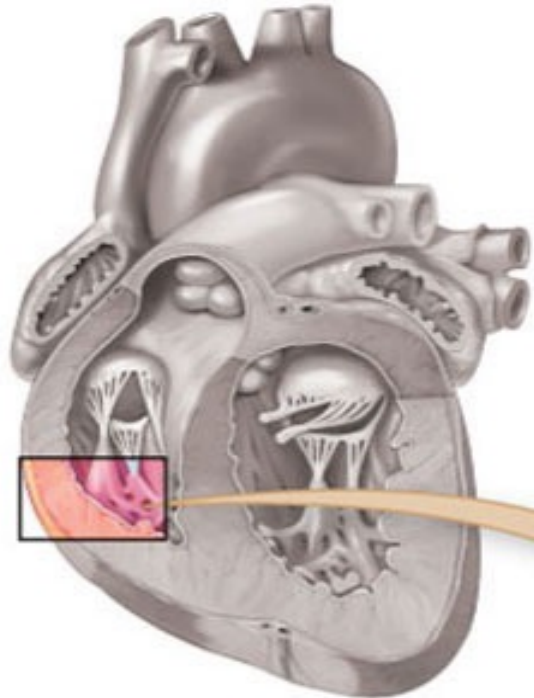




Wall of the Heart



- Structure of the heart
 - Wall of the heart: composed of three distinct layers
 - Epicardium: outer layer of heart wall
 - Myocardium: thick, contractile middle layer of heart wall; compresses the heart cavities, and the blood within them, with great force
 - Endocardium: delicate inner layer of endothelial tissue



Atria of the Heart Receiving Vessels



- Superior chambers
- Are the receiving chambers of the heart
- Atria alternately contract and relax to receive blood and then push it into ventricles
- Only a minimal contraction is needed to push the blood “downstairs” to the ventricles.
- Each atrium has a protruding auricle
- Blood enters right atria from superior and inferior venae cavae and coronary sinus
- Blood enters left atria from pulmonary veins

Ventricles of the Heart Discharging Chambers

- Inferior chambers
- Ventricles are the discharging chambers of the heart – The actual heart pumps
- The ventricles make up most of the volume of the heart
- Right ventricle pumps blood into the pulmonary trunk
- Left ventricle pumps blood into the aorta

Heart Valves

An anatomical illustration of the human heart and its major blood vessels. The heart is shown in a reddish-brown color, with the four heart valves (tricuspid, bicuspid, aortic, and pulmonary) highlighted in yellow. The major blood vessels, including the aorta, pulmonary artery, and pulmonary veins, are shown in blue and red. The background is a light blue grid.

- Heart valves ensure unidirectional blood flow through the heart
- Atrioventricular (AV) valves lie between the atria and the ventricles
 - Tricuspid and bicuspid
- Semilunar valve lies between the ventricles and the great vessels
 - Aortic and pulmonary

Atrioventricular (AV) Valves

An anatomical illustration of the human heart and its major blood vessels. The heart is shown in a frontal view, with the right atrium and ventricle on the left side of the image and the left atrium and ventricle on the right. The AV valves are highlighted in yellow. The pulmonary artery and pulmonary veins are shown in blue, while the aorta and other systemic arteries are shown in red. The background features a grid pattern and a faint ECG line.

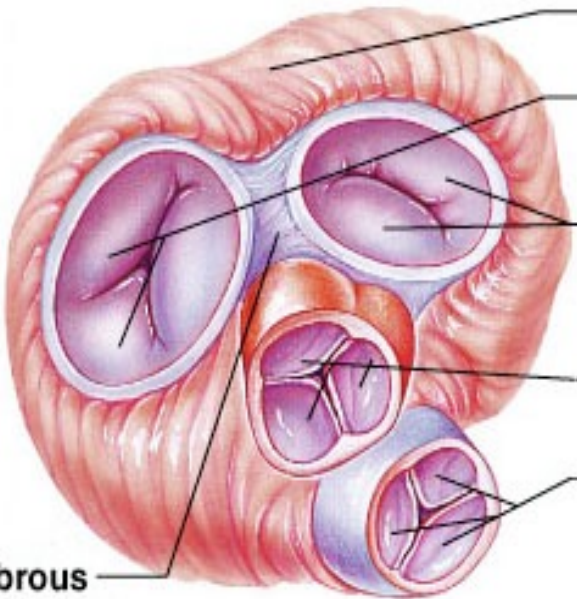
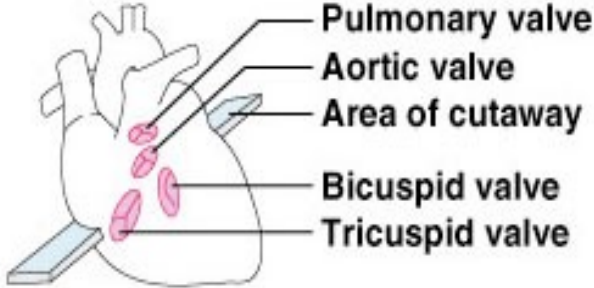
- Atrioventricular (AV) valves: prevent blood from flowing back into the atria from the ventricles when the ventricles contract
 - Tricuspid valve (right AV valve): guards the right atrioventricular orifice; free edges of three flaps of endocardium are attached to papillary muscles by chordae tendineae
 - Bicuspid, or mitral, valve (left AV valve): similar in structure to tricuspid valve except has only two flaps

Semilunar (SL) Valves

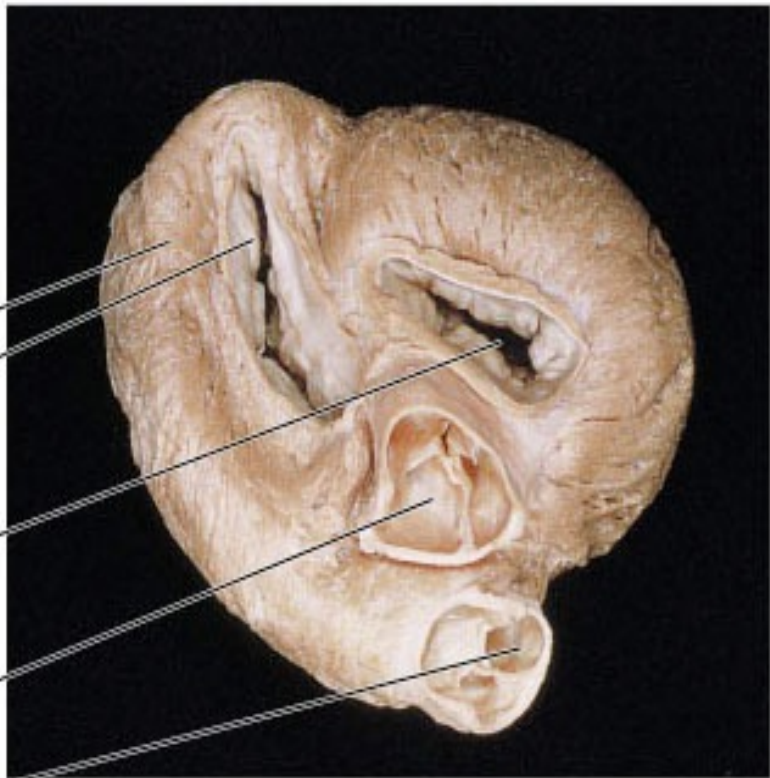
An anatomical illustration of the human heart and its major blood vessels. The heart is shown in a reddish-brown color, with the pulmonary artery and aorta extending from it. The pulmonary artery is shown in red, and the aorta is shown in blue. The heart skeleton is depicted as a series of interconnected rings, shown in a light blue color. The background is a light blue grid.

- Semilunar valves: half-moon-shaped flaps growing out from the lining of the pulmonary artery and aorta; prevent blood from flowing back into the ventricles from the aorta and pulmonary artery
 - Pulmonary valve: valve at entrance of the pulmonary artery
 - Aortic valve: valve at entrance of the aorta
- Skeleton of the heart
 - Set of connected rings that serve as a semirigid support for the heart valves and the attachment of cardiac muscle of the myocardium
 - Serves as an electrical barrier between the myocardium of the atria and that of the ventricles

Heart Valves



- Myocardium
- Tricuspid valve (right atrioventricular)
- Bicuspid (mitral) valve (left atrioventricular)
- Aortic semilunar valve
- Pulmonary semilunar valve

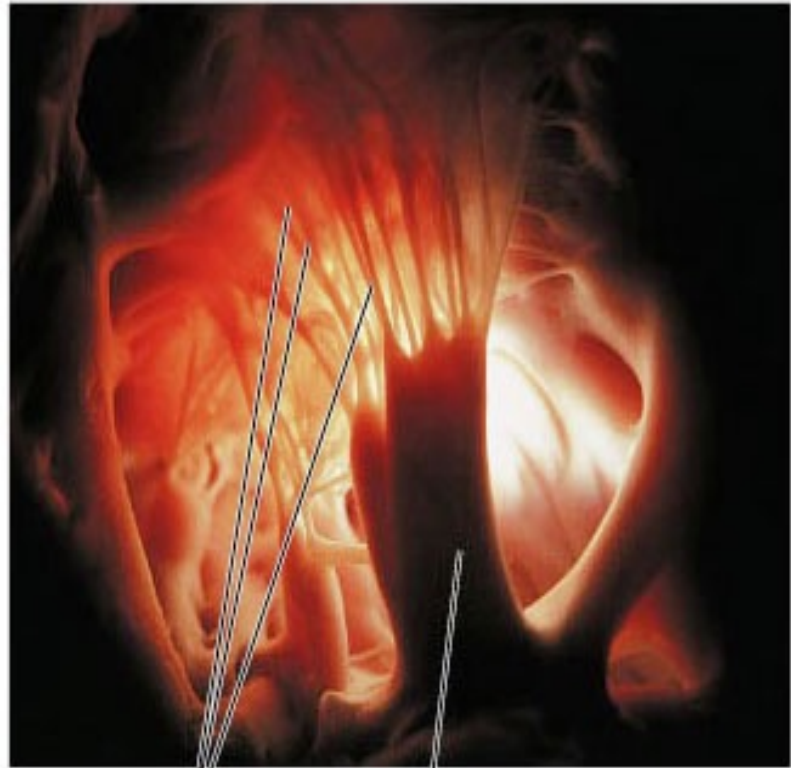


(b)

Fibrous skeleton
Anterior

(a)

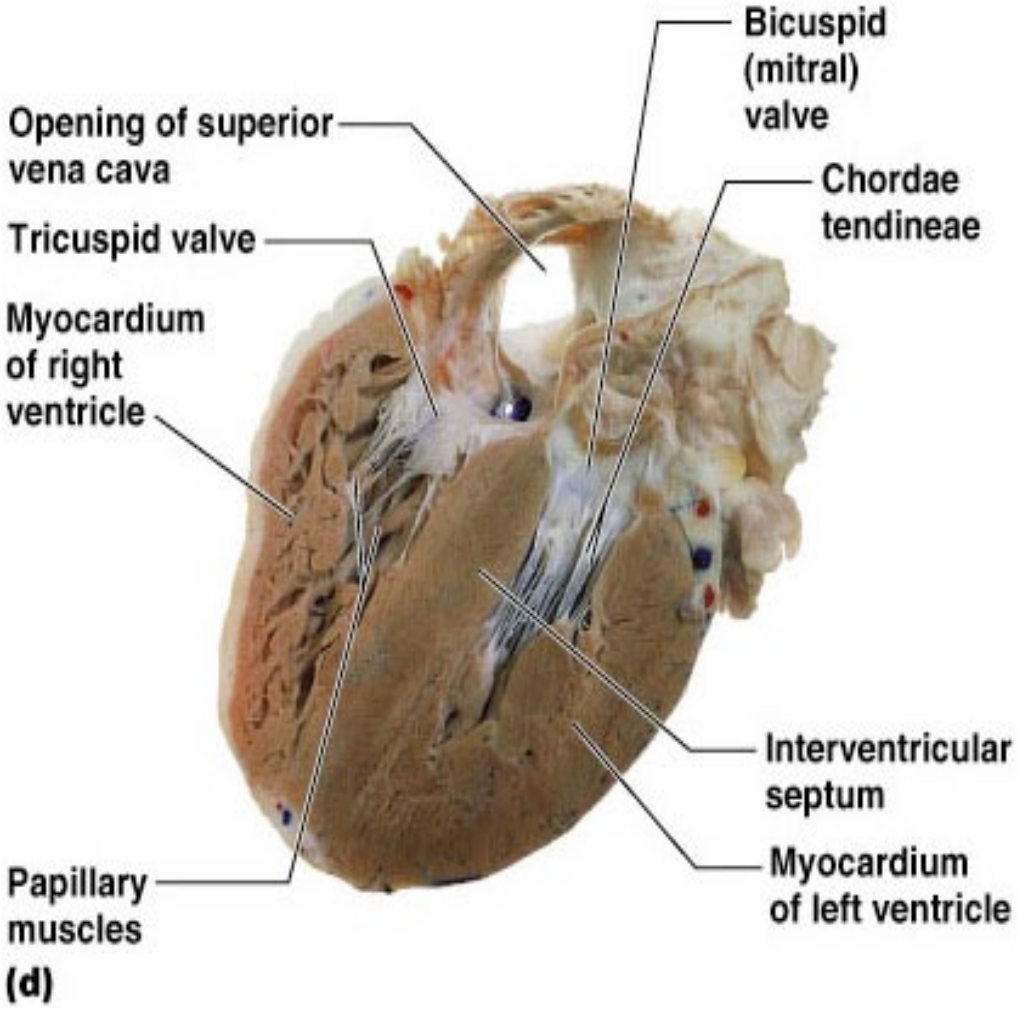
Heart Valves



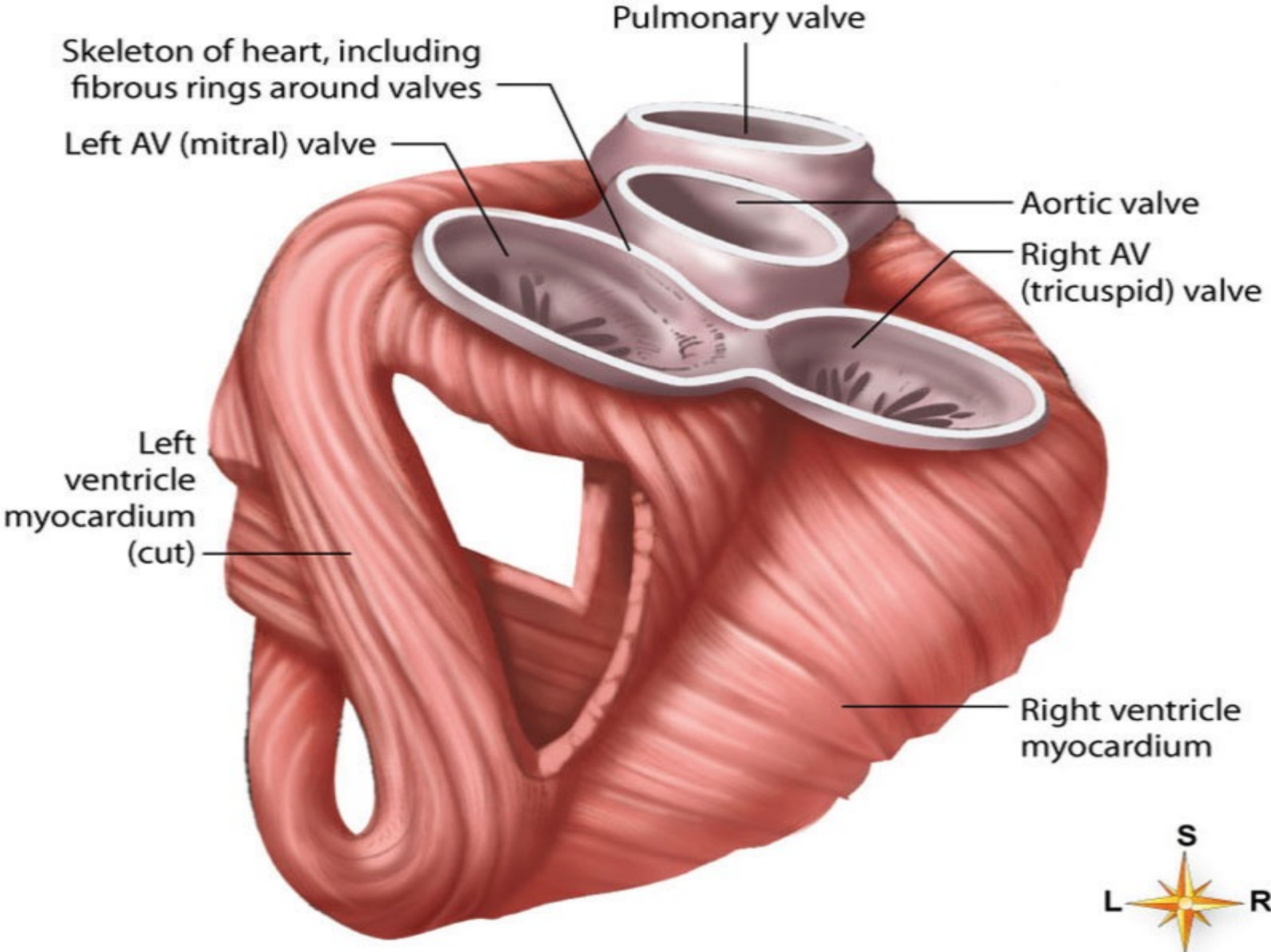
Chordae tendineae attached to tricuspid valve flap

Papillary muscle

(c)



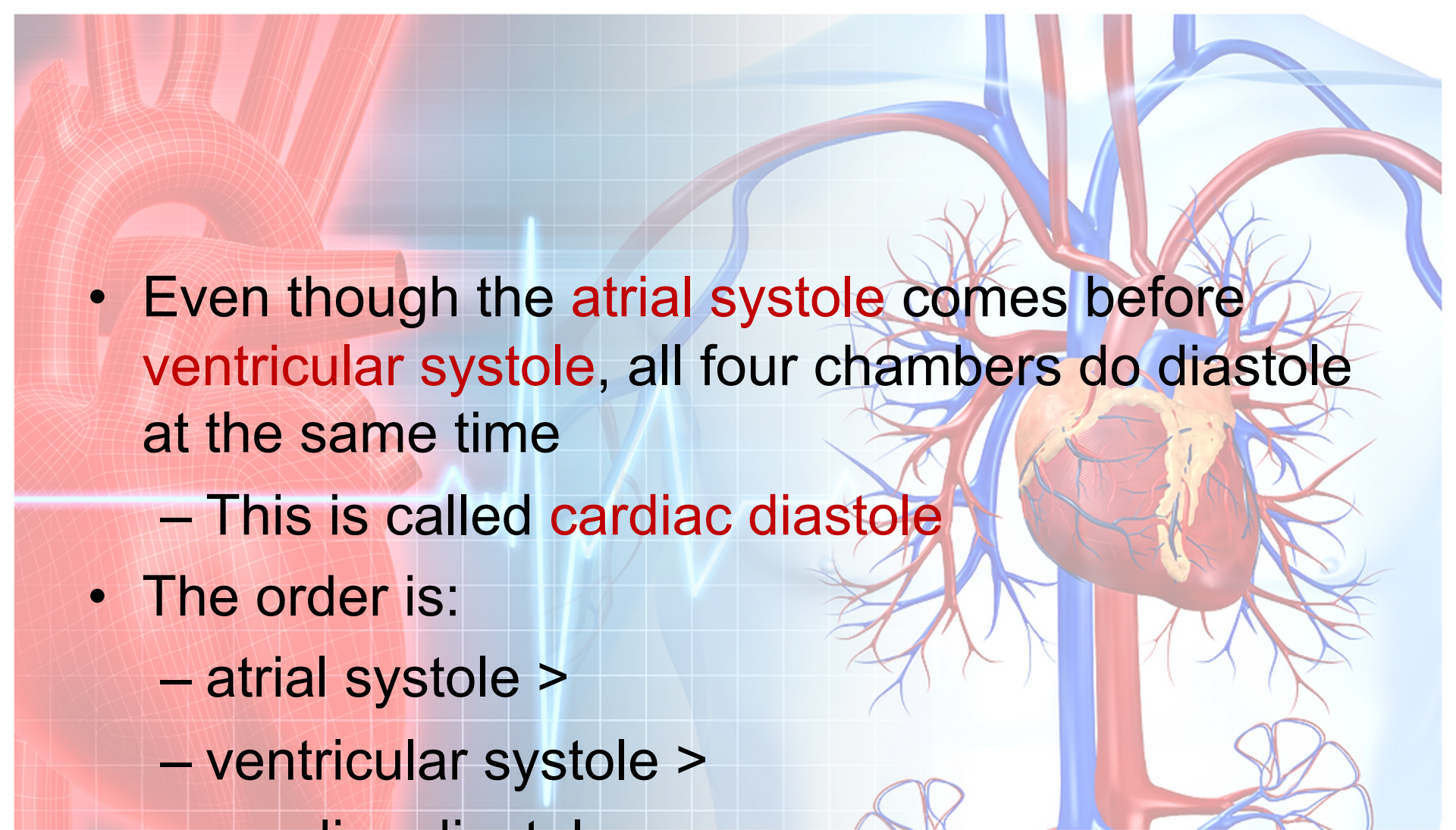
(d)



Cardiac Cycle



- Cardiac cycle: a complete heartbeat consisting of contraction (systole) and relaxation (diastole) of both atria and both ventricles
- When the heart muscle contracts (pushes in) it is called **systole**
- When the heart muscle relaxes (stops pushing in), this is called **diastole**
- Both atria do systole together
- Both ventricles do systole together
- But the atria do systole *before* the ventricles

- 
- Even though the **atrial systole** comes before **ventricular systole**, all four chambers do diastole at the same time
 - This is called **cardiac diastole**
 - The order is:
 - atrial systole >
 - ventricular systole >
 - cardiac diastole
 - When this happens one time, it is called a cardiac cycle

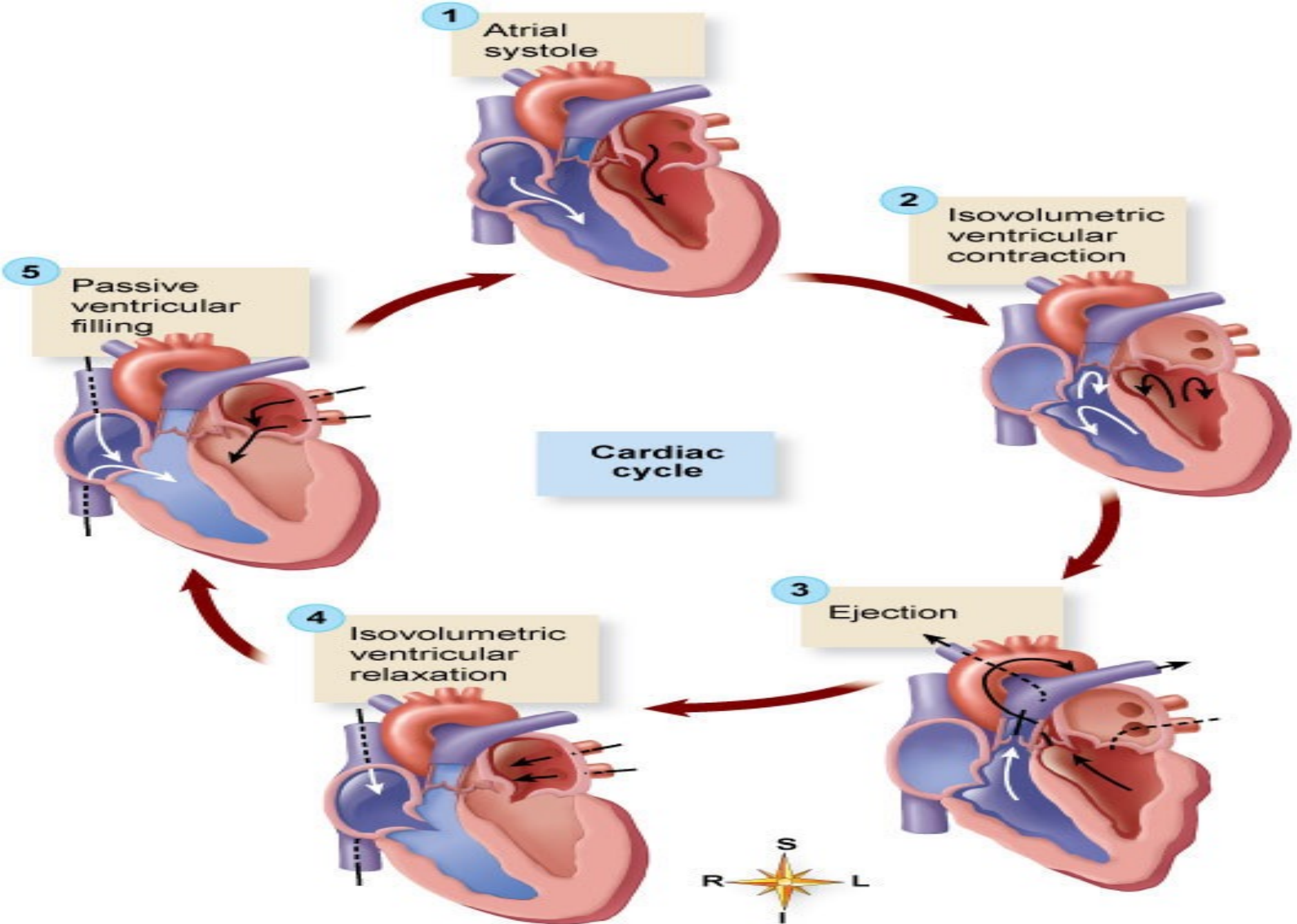
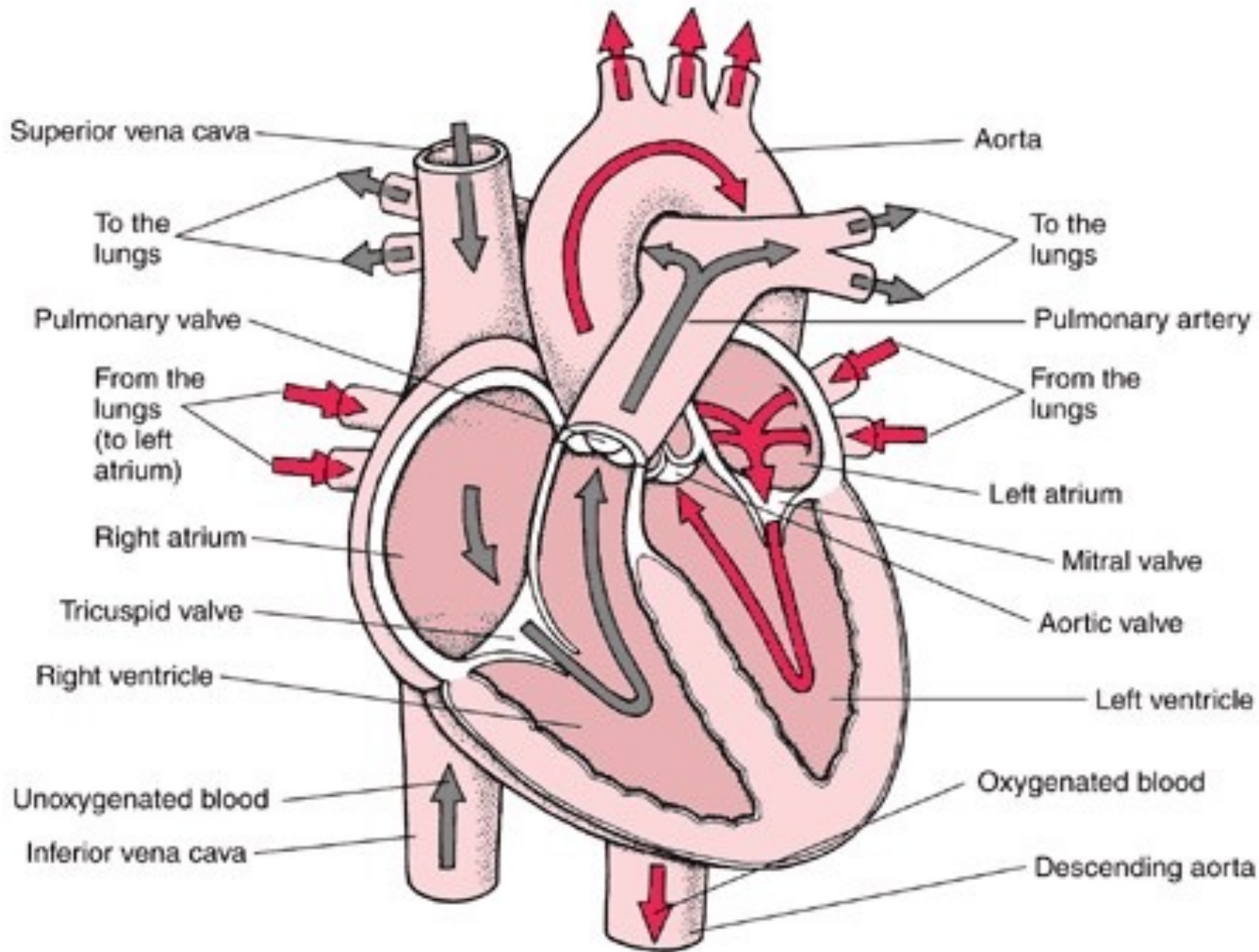


Fig. 19-8. **The cardiac cycle.** The five steps of the heart's pumping cycle described in the text are shown as a series of changes in the heart wall and valves.



The Cardiac Cycle



Cardiac Cycle- sequence of repeating pumping action of the heart

- **Systole**- ventricles contract
- **Diastole**- ventricles relax

Cardiac Performance- maintenance of appropriate pressure throughout circulatory system

$$CO = HR \times SV$$

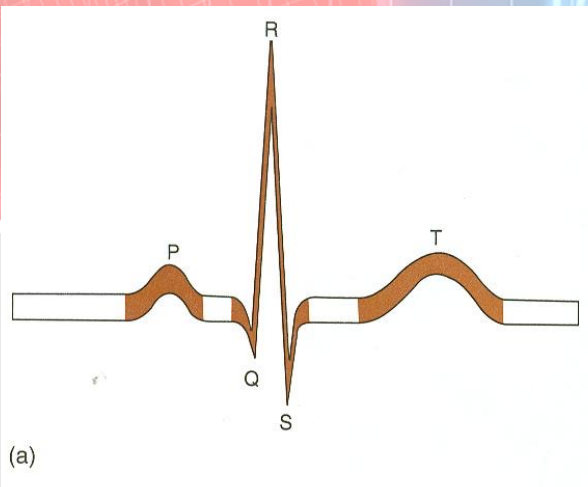
Heart Rate Control

P wave- Electrical signal for atria to depolarize and contract

QRS complex- ventricles depolarize and contract

T wave- ventricles repolarize

Absolute refractory period- cardiomyocytes are unresponsive to any further stimulation



Electrocardiogram (ECG)

Heart Disease



Heart Failure - ventricles failed to maintain blood circulation despite adequate venous filling

- Typically the left ventricle (workload)
- Has **MANY** different causes (diseases and defects)
 - a. Left or Right sided heart failure
 - b. Low or High output heart failure

Heart Disease



Acute Heart Failure

- Characterized by quick development (seconds to days)
- Patients often recover (~65%)

Chronic Heart Failure

- Characterized by slow development
- More difficult for the body to “adapt”

Pericardial Diseases

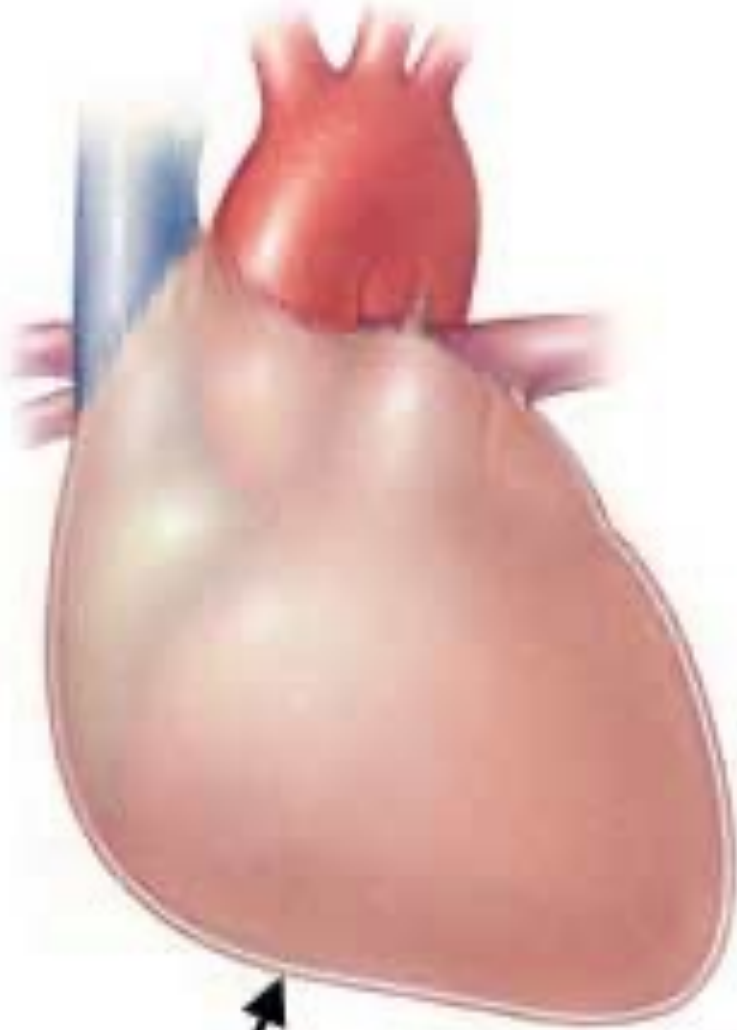


Pericardial Effusion- Too much fluid in the pericardial space

- **Hydropericardium**- Too much serous fluid in space
- **Hemopericardium**- Too much blood in the space

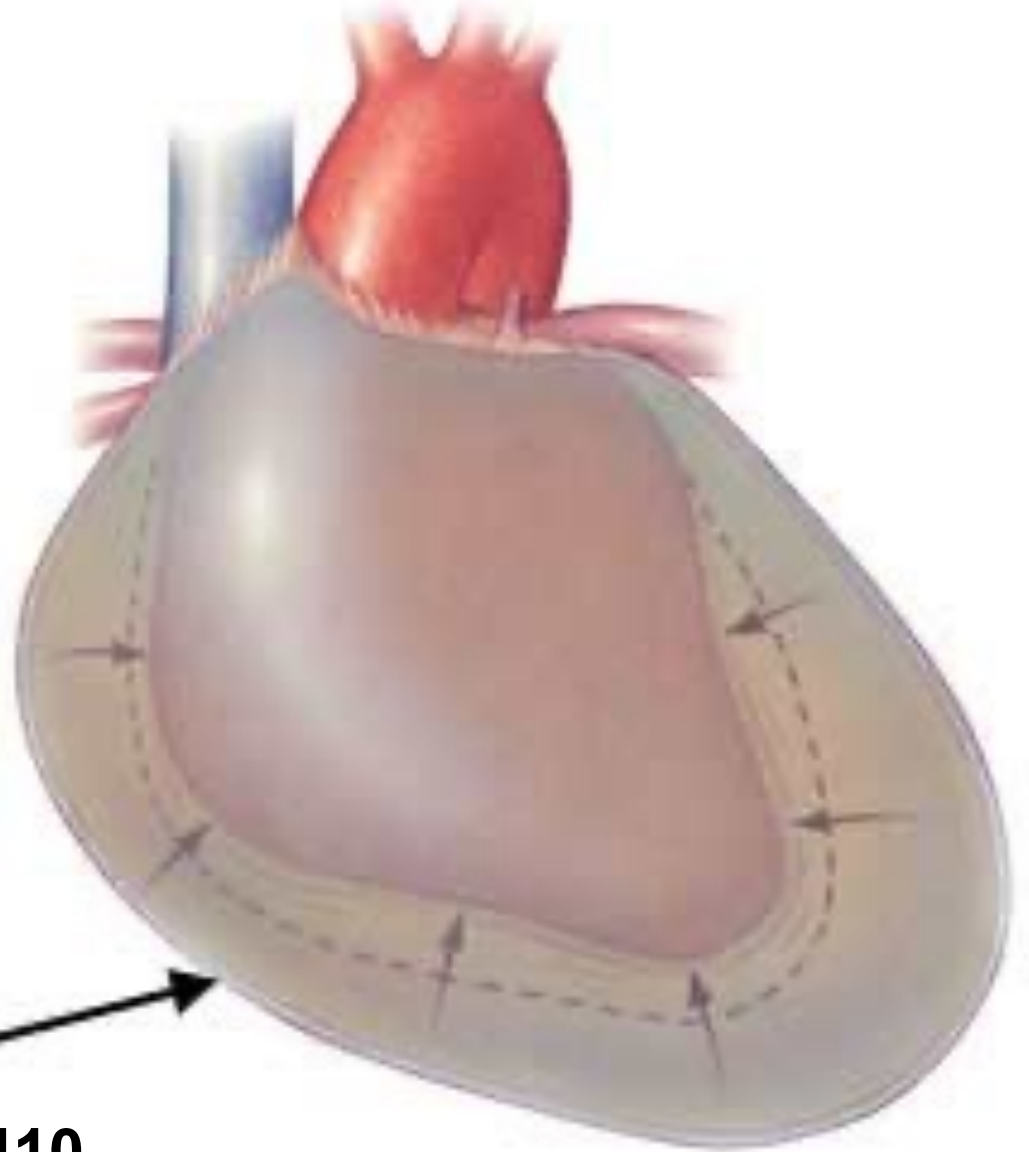
Purulent Effusion - Pus infiltrates pericardium, often a result of bacterial or fungal infection

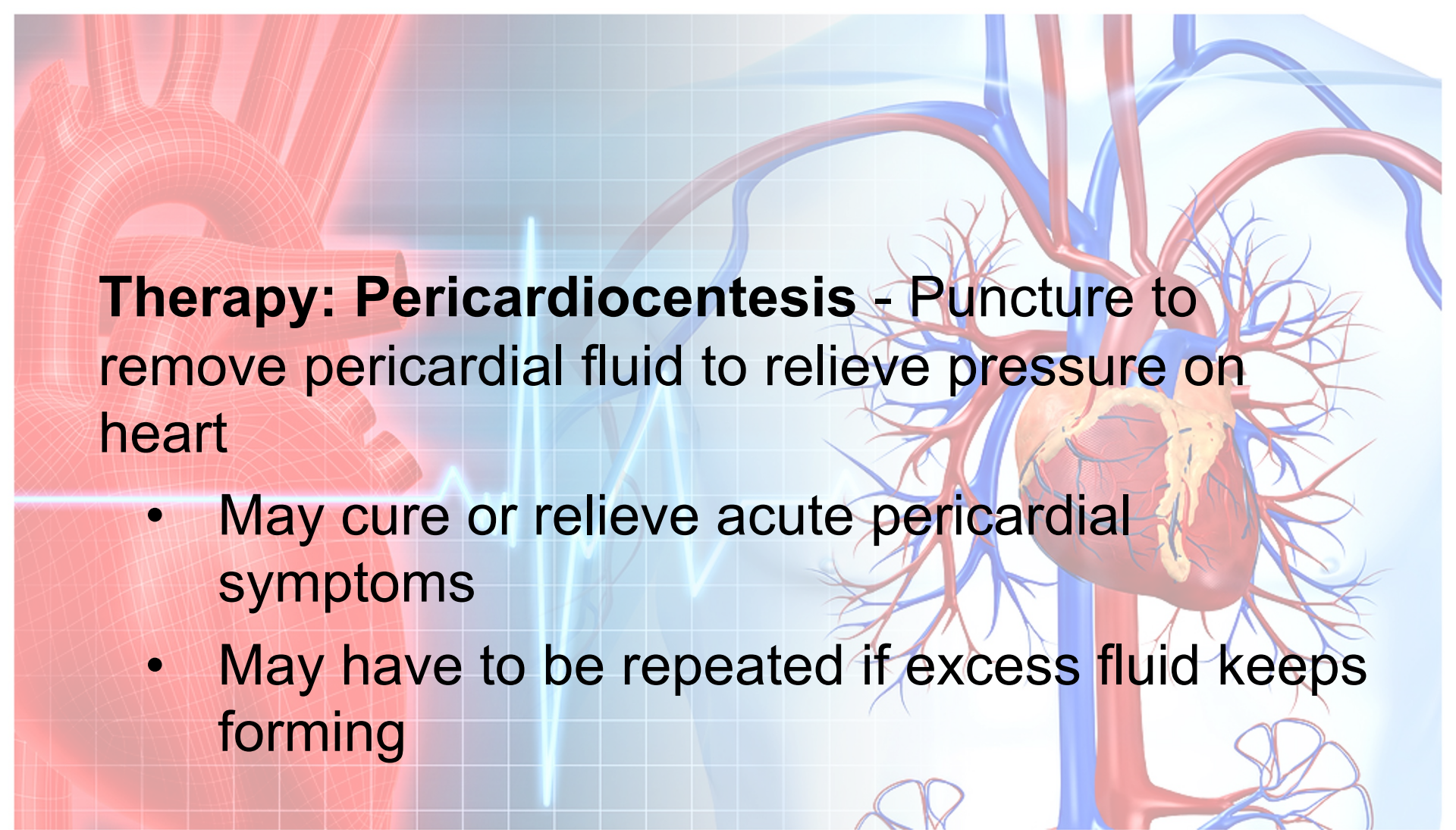
Normal pericardium



Pericardial sac

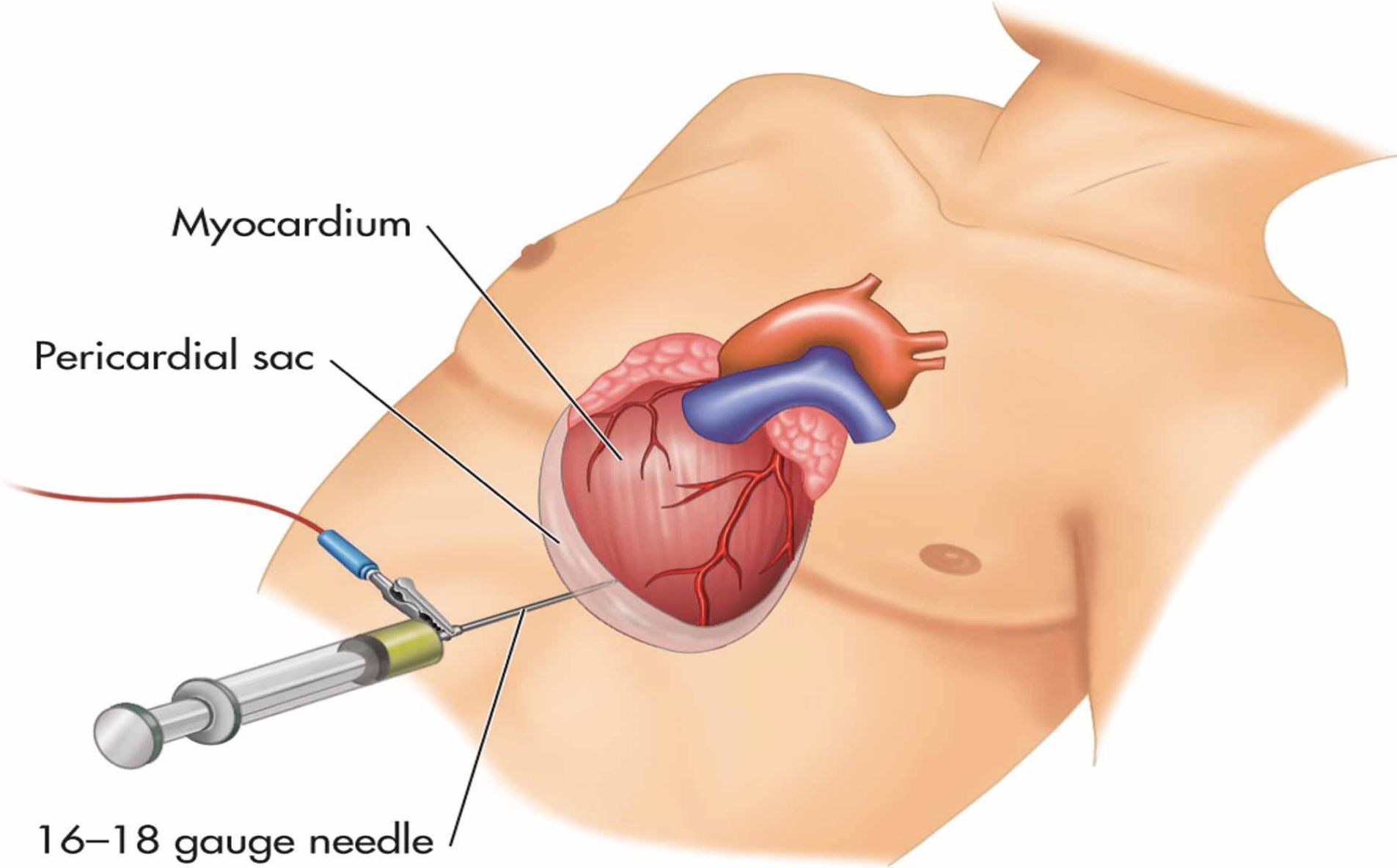
Pericardial effusion





Therapy: Pericardiocentesis - Puncture to remove pericardial fluid to relieve pressure on heart

- May cure or relieve acute pericardial symptoms
- May have to be repeated if excess fluid keeps forming



Myocardium

Pericardial sac

16-18 gauge needle

Inflammatory Diseases



Myocarditis- Inflammation of the myocardium

- Often caused by many different viruses
- Symptoms include:
 - **Acute** – Fever, malaise, eye swelling, constipation
 - **Chronic** – irregular heart beat, inflammation, heart failure, difficulty swallowing due to enlarged esophagus

Inflammatory Diseases



Chagas' Disease

- Caused by *Trypanosoma cruzi* (a protozoan)
- Afflicts 30% of population in South America and South Africa.
- Spreads through: bloodsucking bugs, mother to fetus, blood transfusion, organ transplant

Inflammatory Diseases



Infective Endocarditis (IE)- Inflammation of the endocardium; also called bacterial endocarditis

- Invariably fatal; often caused by bacterial infections and fungi
- Characterized by a **vegetation** - can be several cm wide, easily fragmented infective mass that causes a basic lesion, thrombus
- **Acute IE**- 5-10% mortality rate
- **Subacute IE**- 60-80 % mortality rate
 - Develops over 3-6 months
 - Typical patient has preexisting heart condition

Valve Diseases



Valve Incompetence- Inability for valve to fully close → some (40-50%) regurgitation of blood

- Stroke volume increases causing cardiac output to be maintained
 - L ventricle hypertrophy as work load increases, walls thicken, loose elasticity and force as time goes on.
- Heart will eventually be overloaded by excess volume that cannot be cleared, ventricle dilates
- In severe cases there is 80-90% backflow of blood

Valve Diseases



Valvular Stenosis - Narrowing of valve diameter

- **Congestion** - valve fails to open effectively or is obstructed when blood accumulates in upstream chambers of vessels (causes hypertension)
 - **Heart murmurs** - caused by turbulence
- ◎ Either may happen in any of the four types of heart valves (some more often than others)
- ◎ A valve can have stenosis and incompetency simultaneously

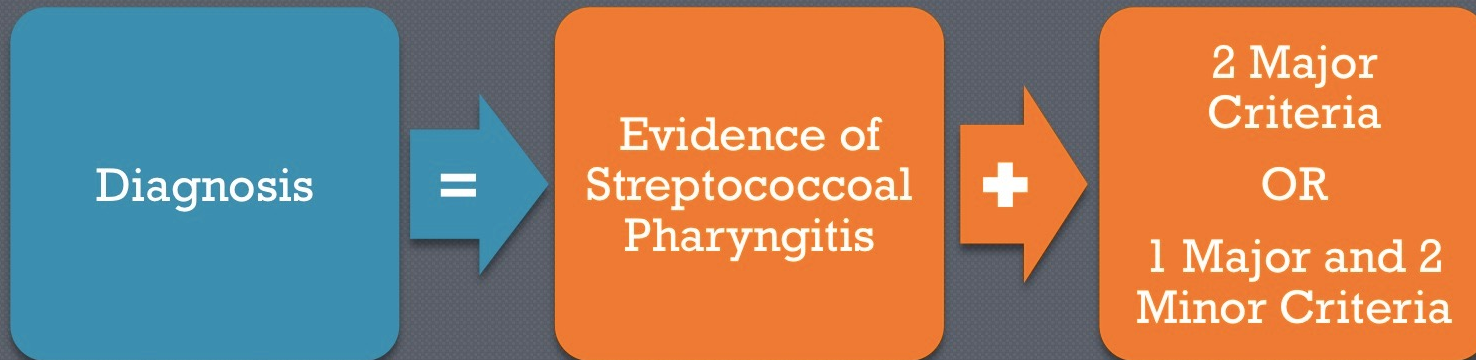
Rheumatic Heart Disease (RHD)



- Caused by the widespread inflammatory disease **rheumatic fever (RF)**
 - Often involves painful joints with much fluid infiltration
 - Started by *S. pyogenes* (Strep. Throat)
- May damage any part of the heart (usually valves)

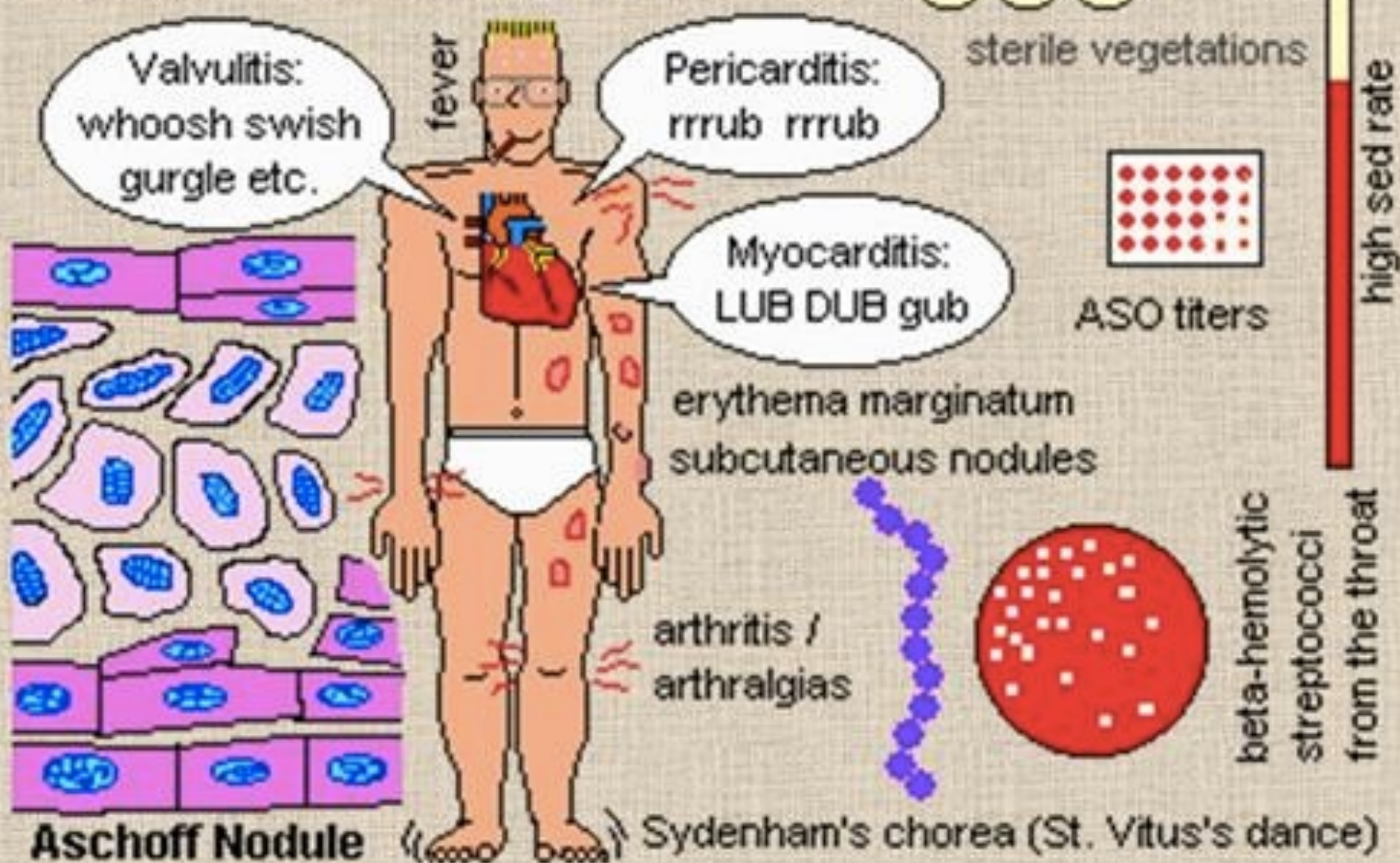
Rheumatic Fever

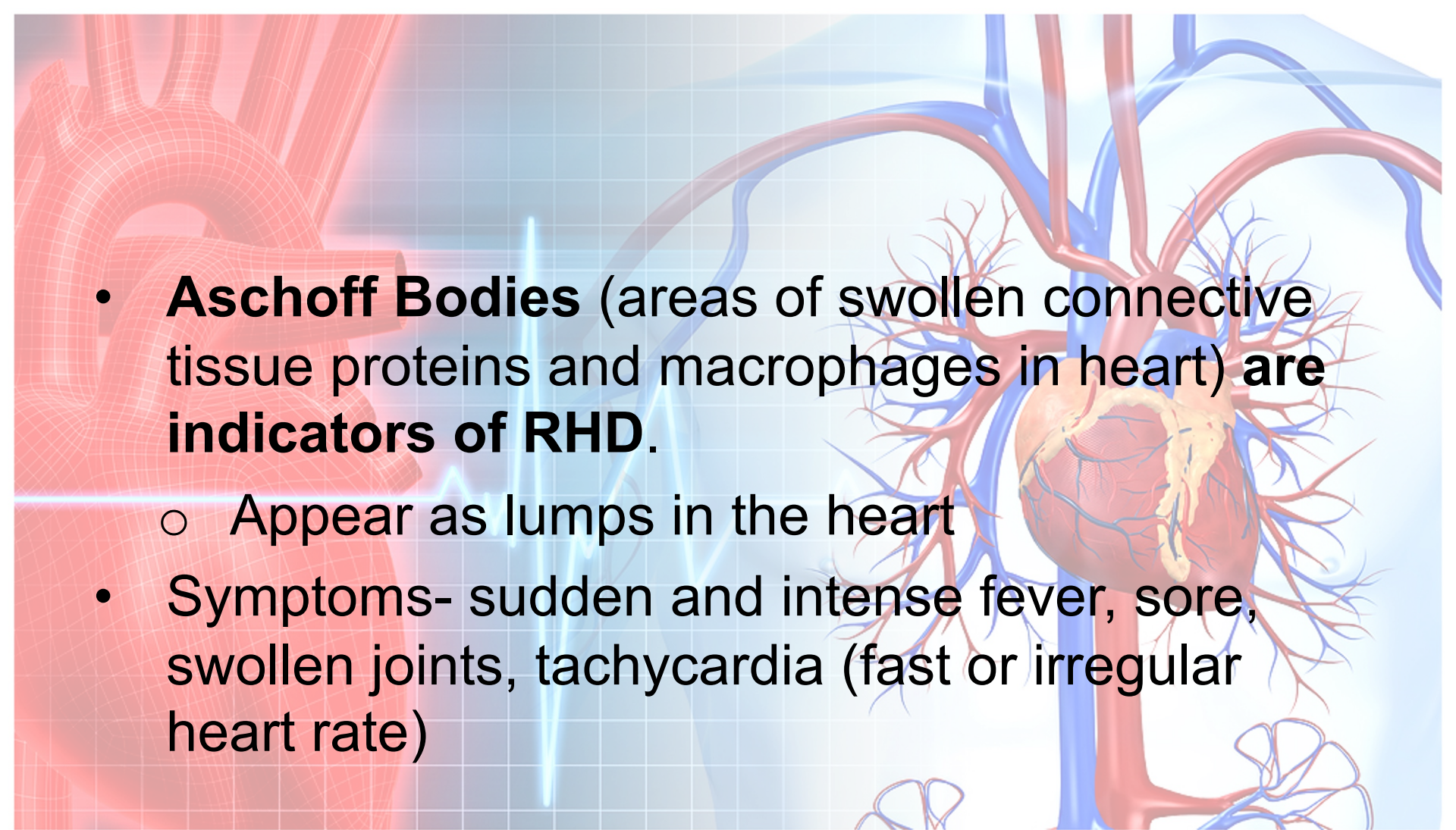
Jones Criteria



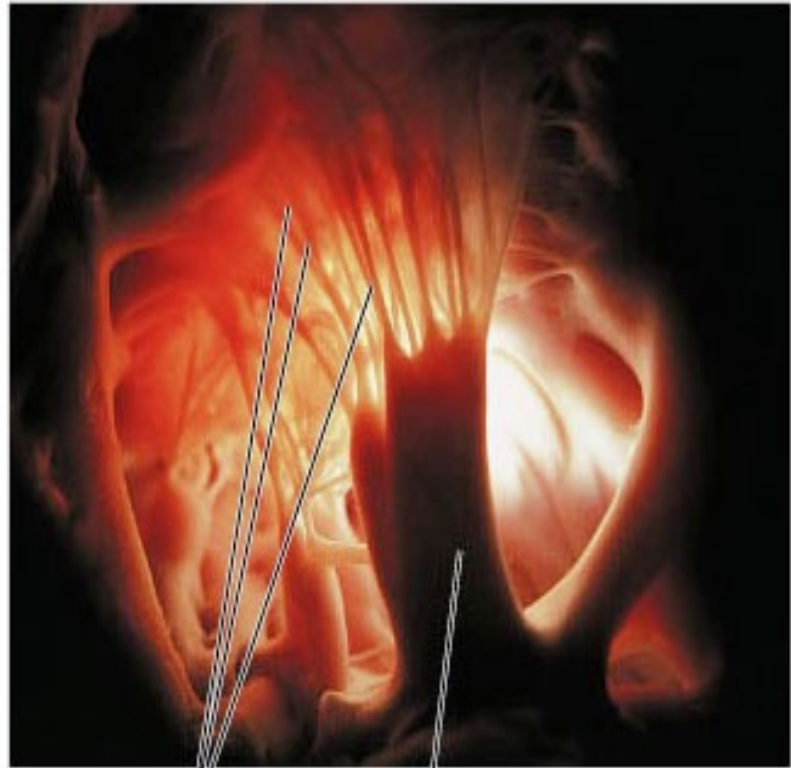
Evidence of Streptococcal Pharyngitis	<ul style="list-style-type: none"> • Positive throat culture for group A beta-hemolytic streptococci • Positive rapid streptococcal antigen test • Elevated or rising antistreptolysin O antibody titer
Major Criteria	<ul style="list-style-type: none"> • Migratory arthritis (predominantly involving the large joints) • Carditis and valvulitis (eg, pancarditis) • Central nervous system involvement (eg, Sydenham chorea) • Erythema marginatum • Subcutaneous nodules
Minor Criteria	<ul style="list-style-type: none"> • Arthralgia • Fever • Elevated acute phase reactants [erythrocyte sedimentation rate (ESR), C-reactive protein (CRP)] • Prolonged PR interval

Acute Rheumatic Fever



- 
- **Aschoff Bodies** (areas of swollen connective tissue proteins and macrophages in heart) **are indicators of RHD.**
 - Appear as lumps in the heart
 - Symptoms- sudden and intense fever, sore, swollen joints, tachycardia (fast or irregular heart rate)

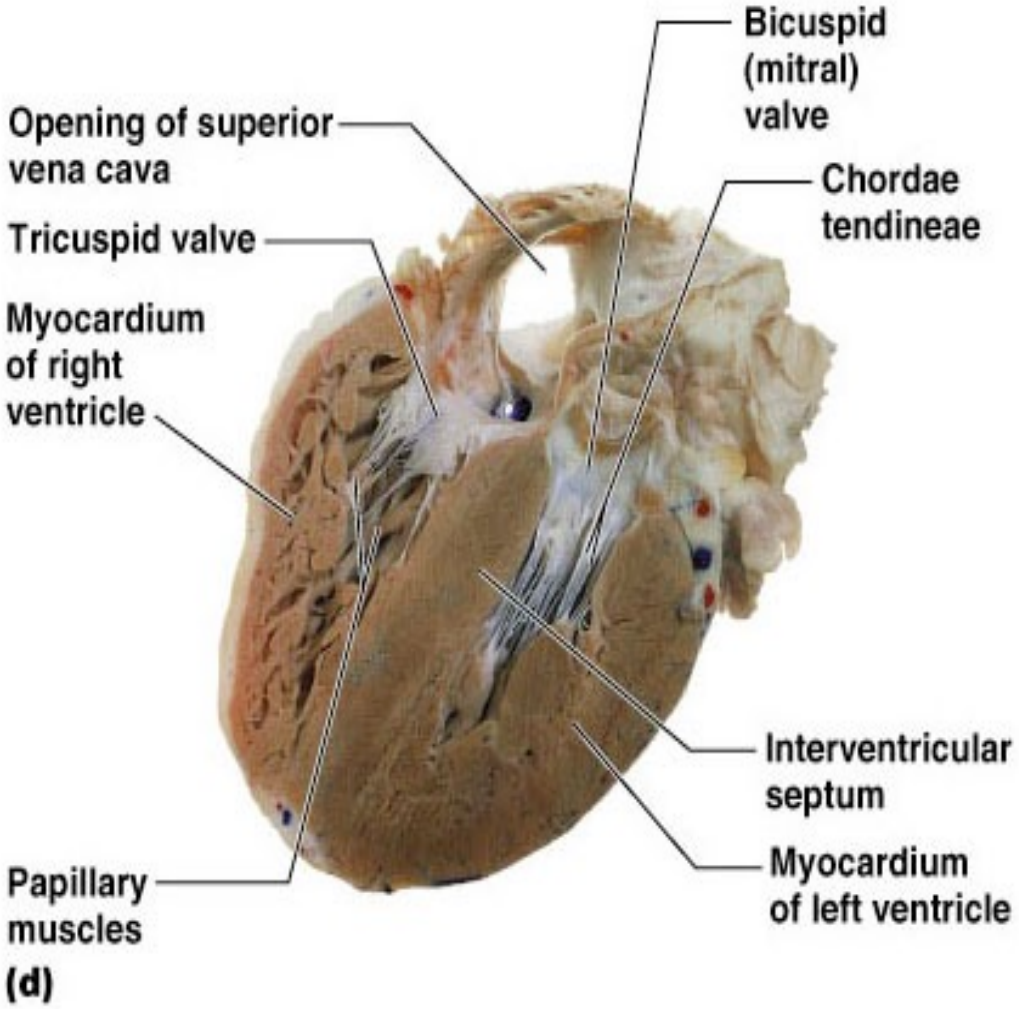
Heart Valves



Chordae tendineae attached to tricuspid valve flap

Papillary muscle

(c)



Opening of superior vena cava

Tricuspid valve

Myocardium of right ventricle

Bicuspid (mitral) valve

Chordae tendineae

Interventricular septum

Myocardium of left ventricle

Papillary muscles

(d)

Heart Valves



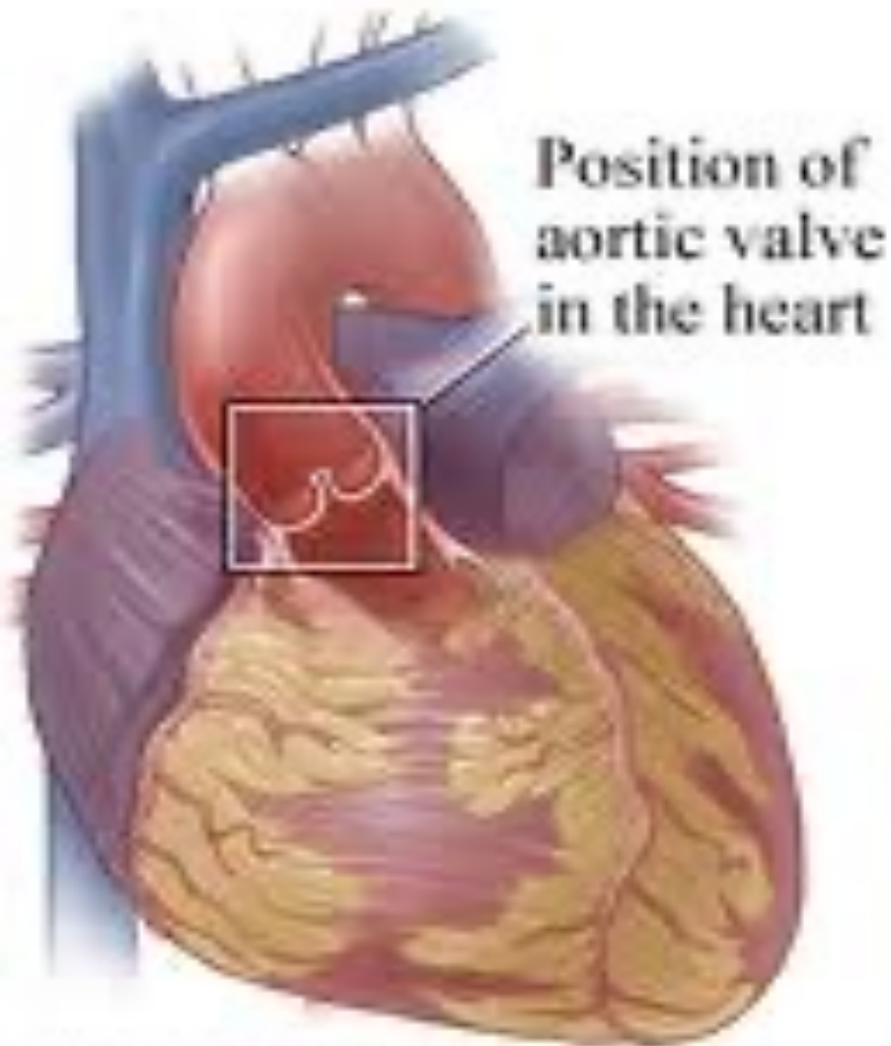
- Mitral regurgitation (insufficiency)
 - In the past, was caused by rheumatic fever
- Mitral stenosis
 - Caused by rheumatic fever, congenital abnormalities, lupus, or tumor

Heart Valves



- Aortic regurgitation (insufficiency)
 - The 3 cusps leak after contraction
 - Caused by rheumatic heart disease, congenital defects, endocarditis or degeneration
 - Causes ventricular enlargement
- Aortic stenosis
 - Most common valve problem in adults
 - Most caused by arteriosclerosis of flaps – normal aging

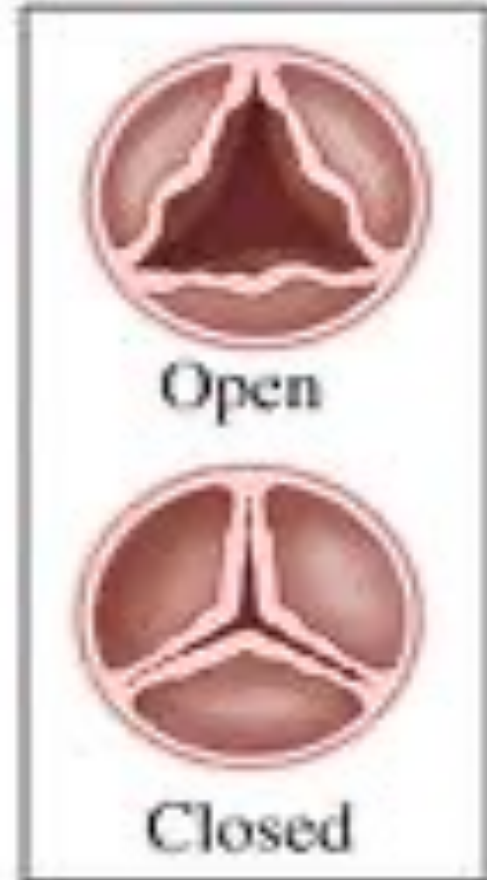
Valve Stenosis



Normal aortic valve



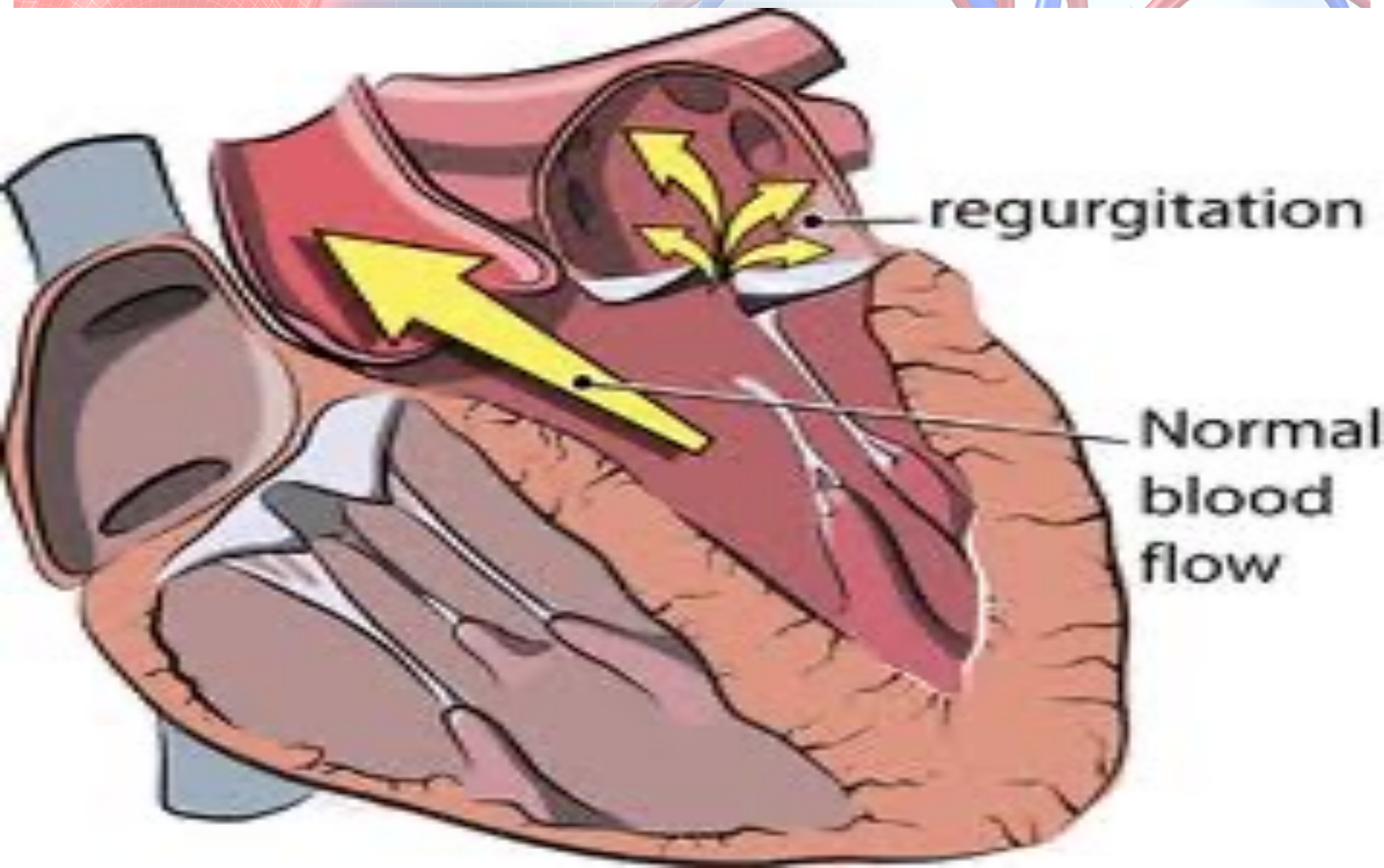
Aortic valve stenosis







Valve Regurgitation



Endocarditis



- Infection of inner heart lining, usually bacterial
 - Can be acute or subacute
 - Usually occur on damaged valves in which the bacteria accumulates and forms blood clots on the valves
 - Bacteria in the bloodstream comes from mouth, dental work, gingivitis, skin infections, medical procedures (*Streptococcus*, *staphylococcus*, *enterococcus*)

Endocarditis



- Heart valve vegetations can and easily embolize throughout the body causing satellite abscesses
- Diagnosis with ECHO and blood culture
 - Consider in any patient with fever heart murmur
- Treatment – IV antibiotics and possible valve replacement

Infective endocarditis is an infection of the heart chambers or valves

