

Clinical Cardiology A & P

A stylized graphic of an ECG waveform. The waveform is white and blue, set against a red background. The waveform shows a P wave, a QRS complex, and a T wave. The background is a gradient of red and blue, with a dark red silhouette of a human torso on the right side.

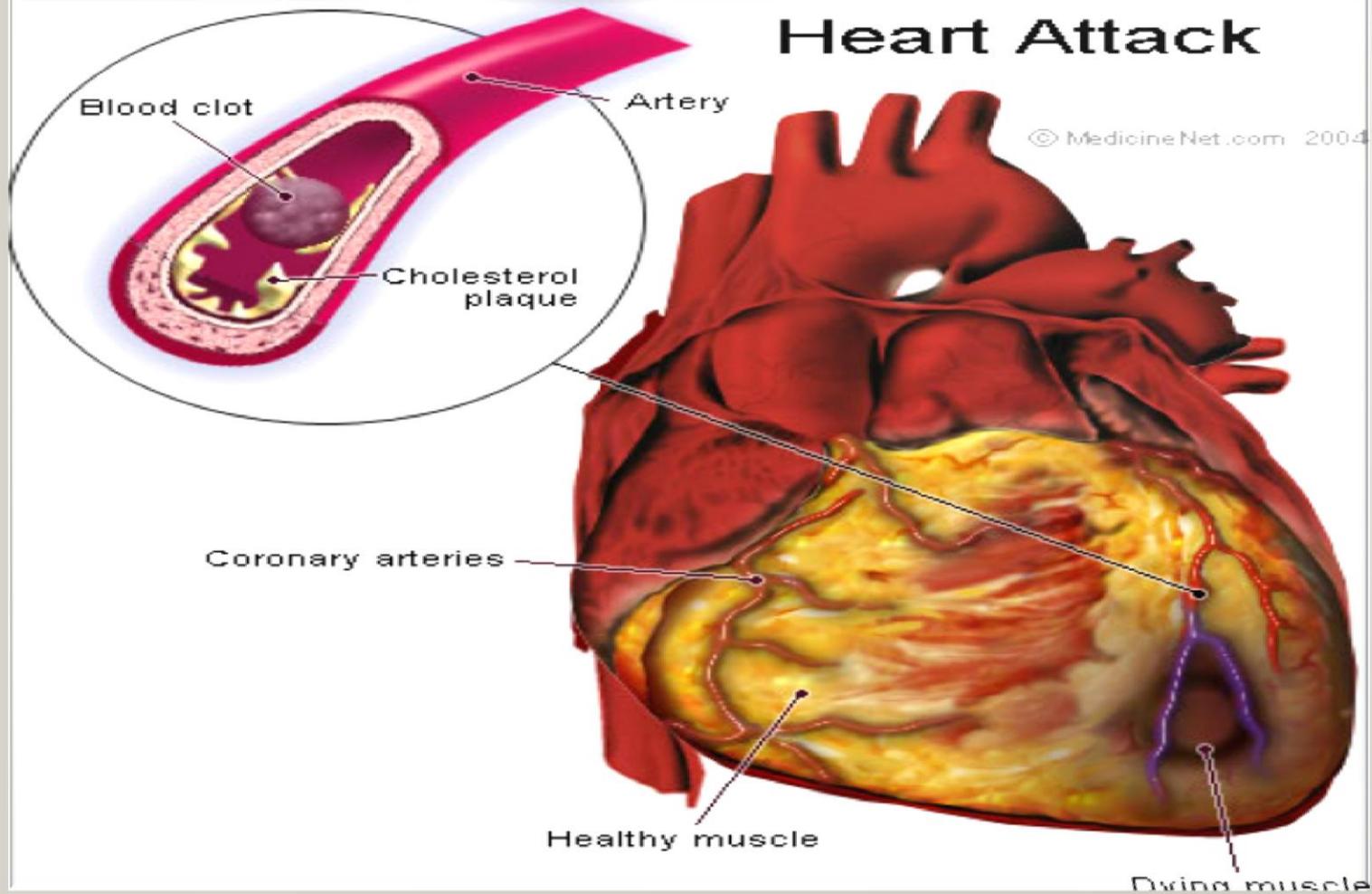
Dr. Gary Mumaugh

Films on Demand Video

The Anatomy of Circulation



Coronary Artery Disease

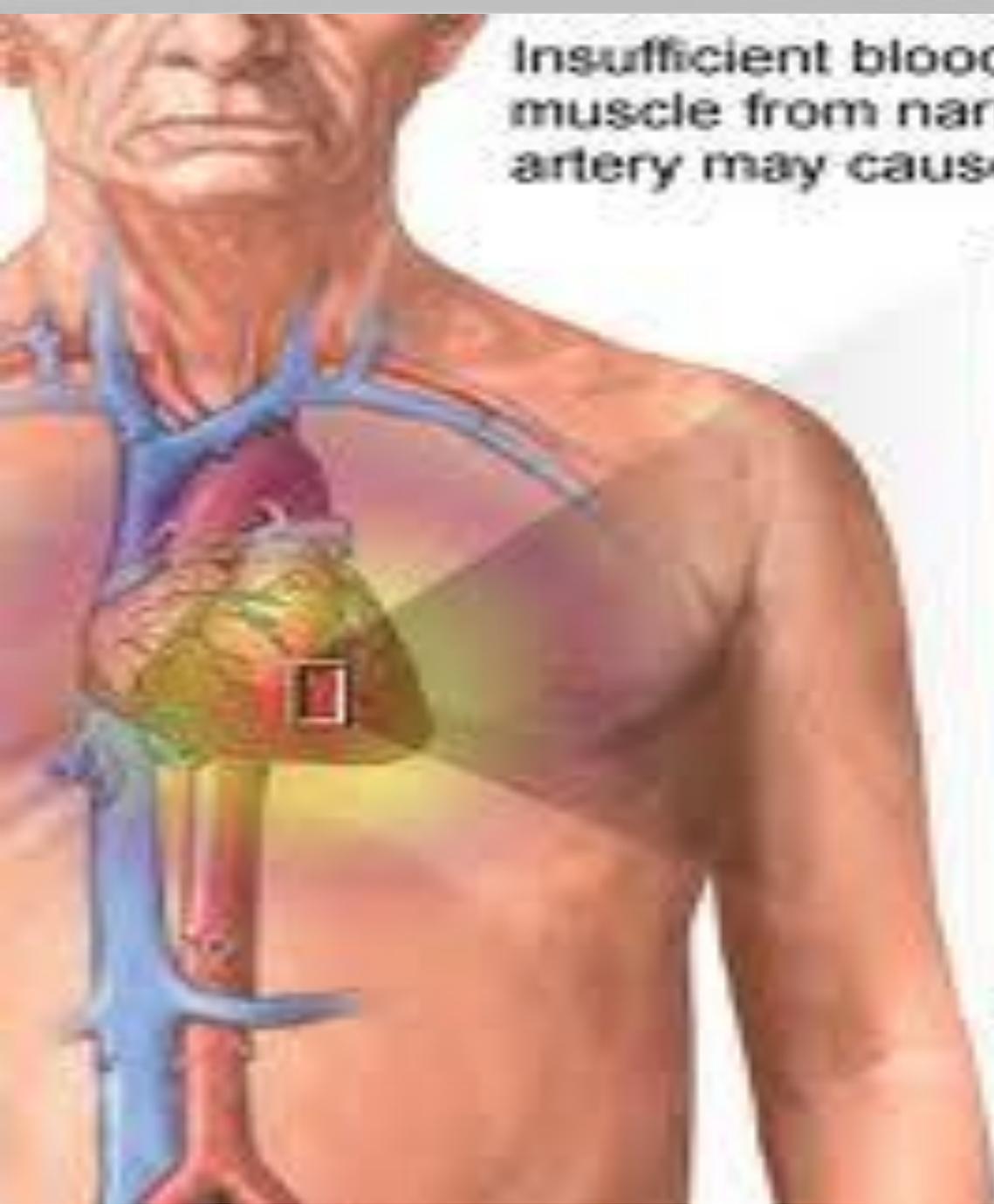




Pathophysiology

- Atherosclerotic disease and coronary artery disease accounts for 45% of all USA deaths
- 50% of female deaths are cardiovascular
- Etiology includes the presence of plaques lining the coronary arteries with plaque rupture and coronary artery spasm
- Result is ischemia, angina or MI, cell death and or electrical dysfunction
- 3 Elements of atherogenesis is plaque formation, plaque rupture, vasoregulation creating atherosclerotic disease

Insufficient blood flow to the heart muscle from narrowing of coronary artery may cause angina (chest pain)



Plaque in
coronary artery

- CAD risk factors

- Older age
- Family history
- Socioeconomic factors
- Overweight with trunk fat deposition
- Blood pressure
- Smoking
- Personality and psychological factors
- Glycemic control
- Increased LDL and triglycerides
- Poor dental hygiene
- Chronic infections
- With several risk factors the risk could be up to 20X



The #1 cardiac risk factor is the presence of anger and hostility

- Preventative therapy to reduce heart attacks
 - Specific therapy for those with pre-clinical CAD
 - Lovastatin and strict diet control
 - Proper diabetic control
 - Antihypertensives
 - Folic acid for high homocysteine
 - Temporary antibiotics
 - Maintenance of good oral hygiene
 - General therapy for all adults
 - Low dose ASA
 - Smoking cessation & stress management
 - Folic acid, Vitamin C and E, omega-3 fatty acids
 - Increasing aerobic exercise

Coronary Artery Occlusion with MI

- Incidence
 - 1,100,000 American had MI, with 650,000 being the first attack and 450,000 instant deaths
- S & S
 - Crushing chest pain with diaphoresis, dyspnea, weakness, palpitations, vomiting
- Diagnosis
 - Patient presentation with ECG and blood tests
- Treatment
 - Admission to CCU has best survival
 - Oxygen, beta blockers, heparin, tPa
 - Pacemaker insertion or CABG surgery

Famous Cardiac Caveats

In all men or older women with acute physical distress of any kind, always think, “Is this a myocardial infarction?”

Such thought has saved thousands of lives

When a young man complains of pain in his heart, it is usually his stomach. When an old man complains of pain in his stomach, it is usually his heart.

- Coronary Artery Disease Overview



- Watch Your Own Heart Attack

Women's Heart Attacks Misunderstood |
Video - ABC News





**Heart
Attack
Warning
Signs**

Common Early Symptoms

Occurring Before a Heart Attack in Women





Hypertension

- Up to 50 million in the USA
- 95% diagnosed as essential
- Essential means preventable or likely due to diet, obesity, inactivity, stress and alcohol
- Conventional treatment with lifestyle modifications work well with integrative care
 - According to the 6th Joints Commission of Hypertension, even with a BP of 140/90, the main intervention is lifestyle intervention before starting medication.
 - This includes weight loss, decrease sodium and alcohol and moderate exercise for one year before starting medication.

- Causes of essential hypertension
 - Heredity
 - Obesity
 - Salt intake
 - Stress
 - Alcohol
- Three diagnostic components of essential HTN
 - Careful history, family history, organ system review, lifestyle evaluation
 - Thorough physical examination
 - Lab studies

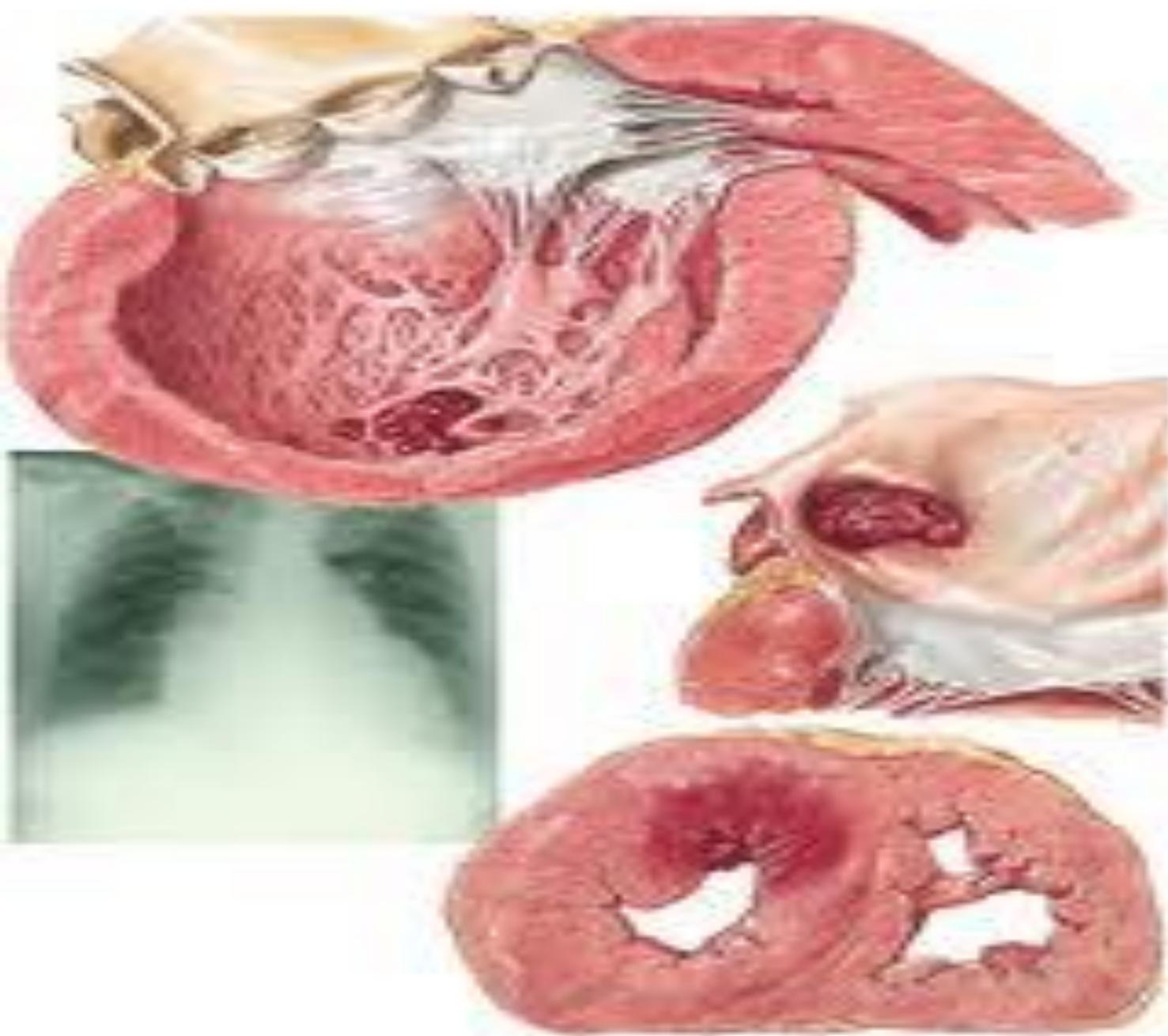
HYPERTENSION



- Treatment of essential HTN
 - Lifestyle changes
 - Weight, exercise, smoking, salt restriction, stress reduction, DASH diet,
 - Medication (only after lifestyle modification)
 - Diuretics
 - Calcium channel blockers
 - ACE inhibitors
 - Alpha blockers
 - Beta-blockers
 - Angiotensin II receptor blockers

- Causes of secondary hypertension
 - “white coat hypertension”
 - Medical noncompliance
 - Exogenous drug usage
 - Oral contraceptives, weight control drugs, NSAIDs, steroids, sympathomimetic cold remedies
 - Renal disease
 - Aldosteronism
 - Endocrine diseases
 - Sleep apnea
 - Congenital stenosis of the aorta
- Treatment of secondary HTN
 - Remove the cause and the HTN is gone

Heart Disease in Hypertension



f. N. ...

Congestive Heart Failure



Congestive Heart Failure

- CHF Incidence
 - In the USA, 3 million hospitalizations per year
 - 30-40% are readmitted with six months
 - 4-5 millions current cases
 - 500,000 – 600,000 new cases per year
 - 250,000 deaths per year
 - Half of all CHF diagnosis die within 5 years
 - 10% die in year one
 - Twice as common in African-Americans
 - USA yearly treatment cost - \$21 billion

- Causes of CHF

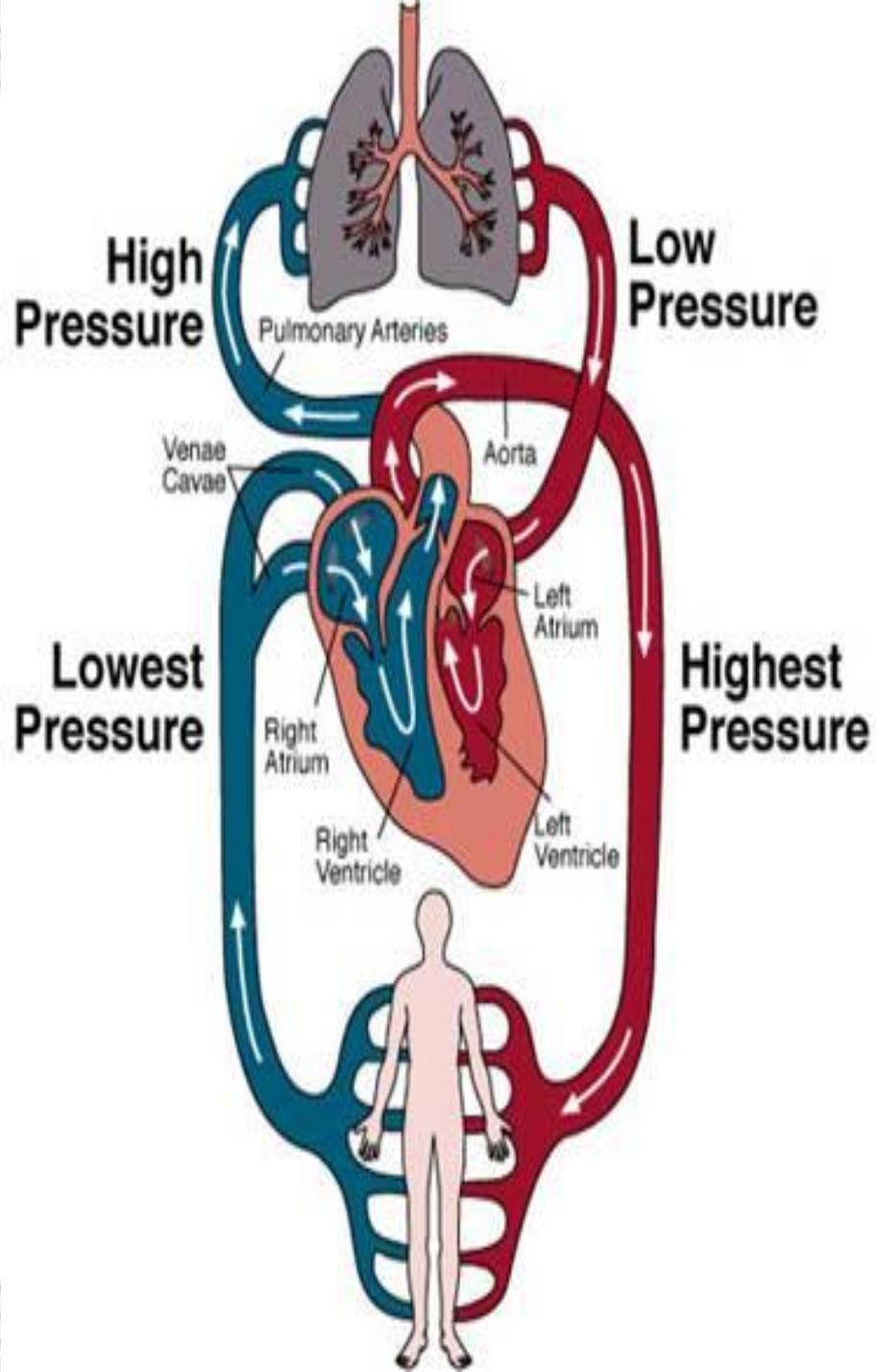
- Coronary artery disease
- Hypertension
- Aortic stenosis and insufficiency
- Mitral regurgitation
- Atrial fibrillation, flutter or tachycardia
- Viral myocarditis
- Septicemia
- Hyperthyroidism or hypothyroidism
- Alcohol abuse
- Chemotherapy
- Congenital or rheumatic heart disease
- Chagas' disease – parasitic heart infection

• Pathophysiology of CHF

- _ The pumping action of the heart becomes less and less powerful
- _ Despite its misleading name, in heart failure the heart doesn't suddenly stop working
- _ Heart failure develops slowly as the heart muscle gradually weakens
- _ The "failure" refers to the heart's inability to pump enough blood.
- _ Blood and fluid do not move efficiently through the circulatory system, and starts to "back up"
- _ Eventually, parts of your body (lungs, abdomen, and lower limbs) hold blood and fluid that your heart isn't circulating very well
- _ This is called "becoming congested," and is why this condition is called "congestive heart failure"

The red circulatory system indicates the flow of oxygenated blood coming from the lung, flowing into the left atrium of the heart, and pumped out to the body by the left ventricle.

The blue circulatory system indicates the flow of blood low in oxygen coming from the body, returning to the right atrium of the heart and pumped out to the lungs by the right ventricle.



Left sided vs. Right sided Heart Failure

- Can involve the heart's left side, right side or both sides, though CHF much more affects the left heart
- Left-sided heart failure
 - Fluid collects in the lungs - this extra fluid in the lungs ("congestion") makes it more difficult for the airways to expand as you inhale
 - Presents with dyspnea, pulmonary edema, and orthopnea
- Right-sided heart failure
 - Due to failure of the right ventricle
 - Fluid collects in other body tissues especially the lower extremities – pitting edema, liver enlargement

- CHF Symptoms

- Three cardinal symptoms are dyspnea, fatigue and fluid retention
- Sudden weight gain, despite loss of appetite
- Swelling in legs, ankles, feet, or abdomen
- Tired and short of breath when doing things that are normally easy, such as walking
- Breathing difficulty when lying flat in bed or may wake up with a choking feeling
 - May need to sleep with your head raised up on several pillows
- Persistent cough, more at night

- CHF Symptoms

- Less frequent urination during the day
- Irregular heartbeats, feeling of heart pounding
- Chest pain, pressure or chest discomfort
- Loss of appetite
- Dizziness or lightheadedness, inability to concentrate

Dilated pupils, a sympathetic nervous system response

Skin pale, gray, or cyanotic

Dyspnea, SOB/OE is early symptom from pulmonary congestion

Orthopnea, cannot breathe unless sitting up

Crackles, wheeze are adventitious breath sounds

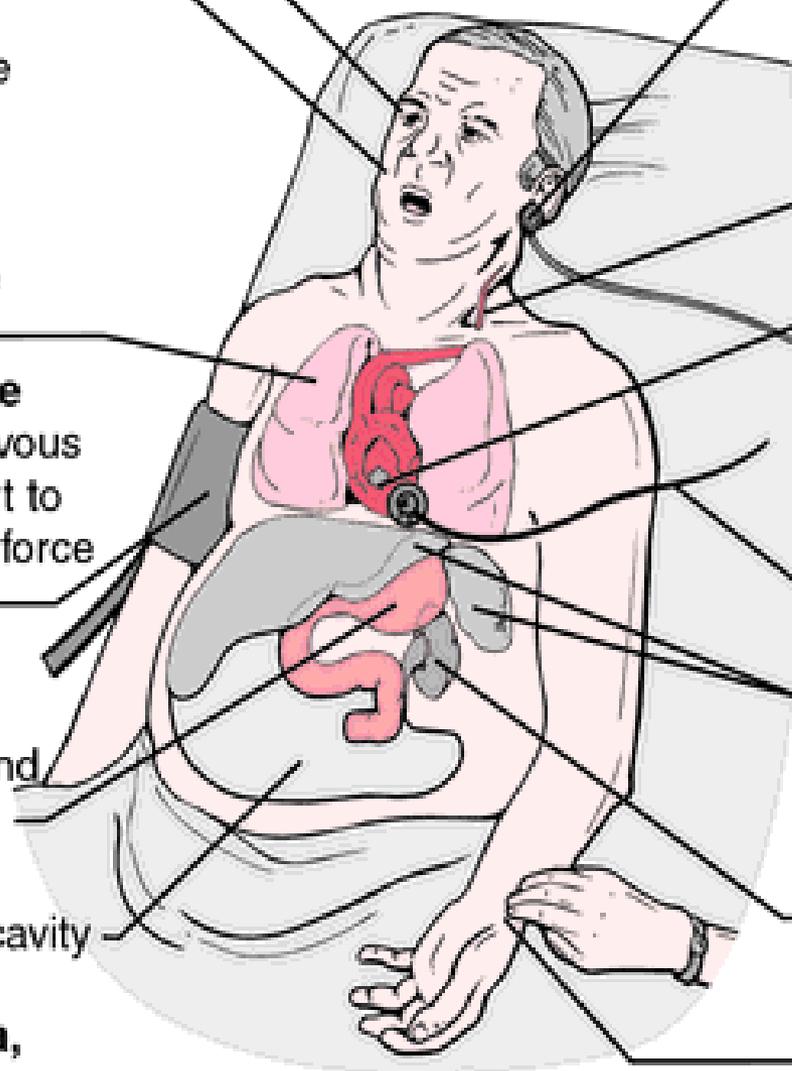
Cough, frothy pink or white sputum

Decreased blood pressure stimulates sympathetic nervous system, which acts on heart to increase rate and increase force of contraction

Nausea and vomiting as peristalsis slows and bile and fluids back up into stomach

Ascites, fluid in peritoneal cavity

Dependent, pitting edema, in sacrum, legs



Anxiety, gasping from pulmonary congestion

Falling O₂ saturation

Confusion, unconsciousness from decreased O₂ to brain

Jugular vein distention from venous congestion

Infarct, may be cause of decreased cardiac output

Fatigue, weakness from decreased cardiac output

S₃ gallop, tachycardia

Enlarged spleen and liver from venous congestion. This causes pressure on breathing

Decreased urine output

Weak pulse
Cool, moist skin

Four Stages of CHF

New York Heart Association Guidelines

- **Class I (Mild) 35%**
 - No limitation of physical activity
 - Ordinary physical activity does not cause symptoms fatigue

- **Class II (Mild) 35%**
 - Slight limitation of physical activity
 - Comfortable at rest, but ordinary physical activity results in fatigue, palpitation, or dyspnea

NYHA - Classifications

- Class III (Moderate) 25%
 - Marked limitation of physical activity
 - Comfortable at rest, but less than any activity causes fatigue, palpitation, or dyspnea

- Class IV (Severe) 5%
 - Unable to carry out any physical activity without discomfort
 - Symptoms of cardiac insufficiency at rest
 - If any physical activity is undertaken, discomfort is increased

• CHF Diagnosis

- Family history
- Medical history
 - HTN, angina, diabetes, high cholesterol, valve disease, PVD, rheumatic disease, chest radiation
- Life style
- Health habits
- Physical exam
 - Peripheral edema, hepatomegaly, ascites, pallor, tachycardia, jugular venous distension
- Chest x-ray
- EKG
- Echocardiogram
- Blood work

Chest X-rays

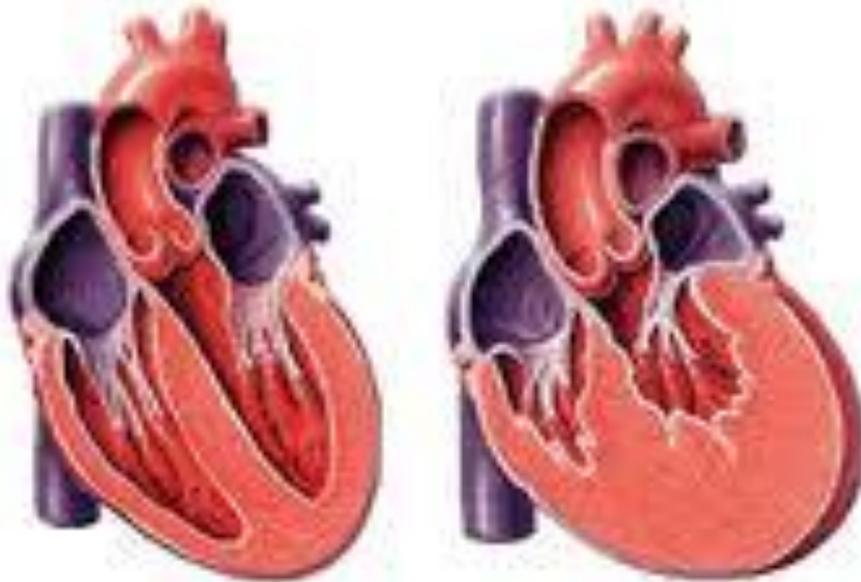


Normal



Cardiomegaly

- 3D Medical Animation Congestive Heart Failure Animation



Normal Heart Congestive Heart

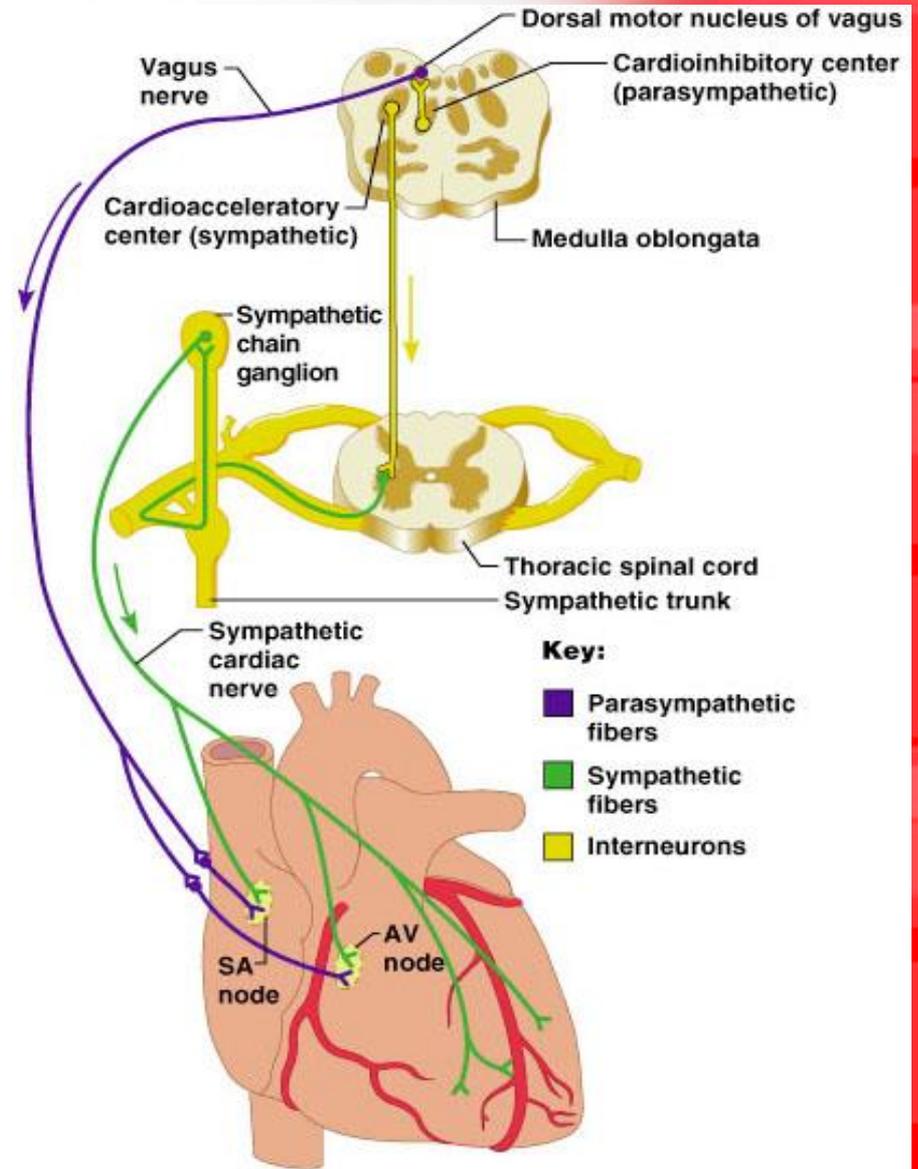


● CHF treatment

- Aldosterone antagonists
 - Reduce the stress to the heart
 - Weak diuretic effect
- Angiotensin converting enzyme (ACE) inhibitors
 - Help reduce the stress on your heart
- Beta blockers
 - Help decrease the heart's need for blood and oxygen by reducing its workload
 - Help the heart to beat more regularly
- Digoxin (Lanoxin®)
 - Help increase the strength of the pumping action
- Diuretics (water pills)
 - Help reduce the amount of fluid in your body

Extrinsic Innervation of the Heart

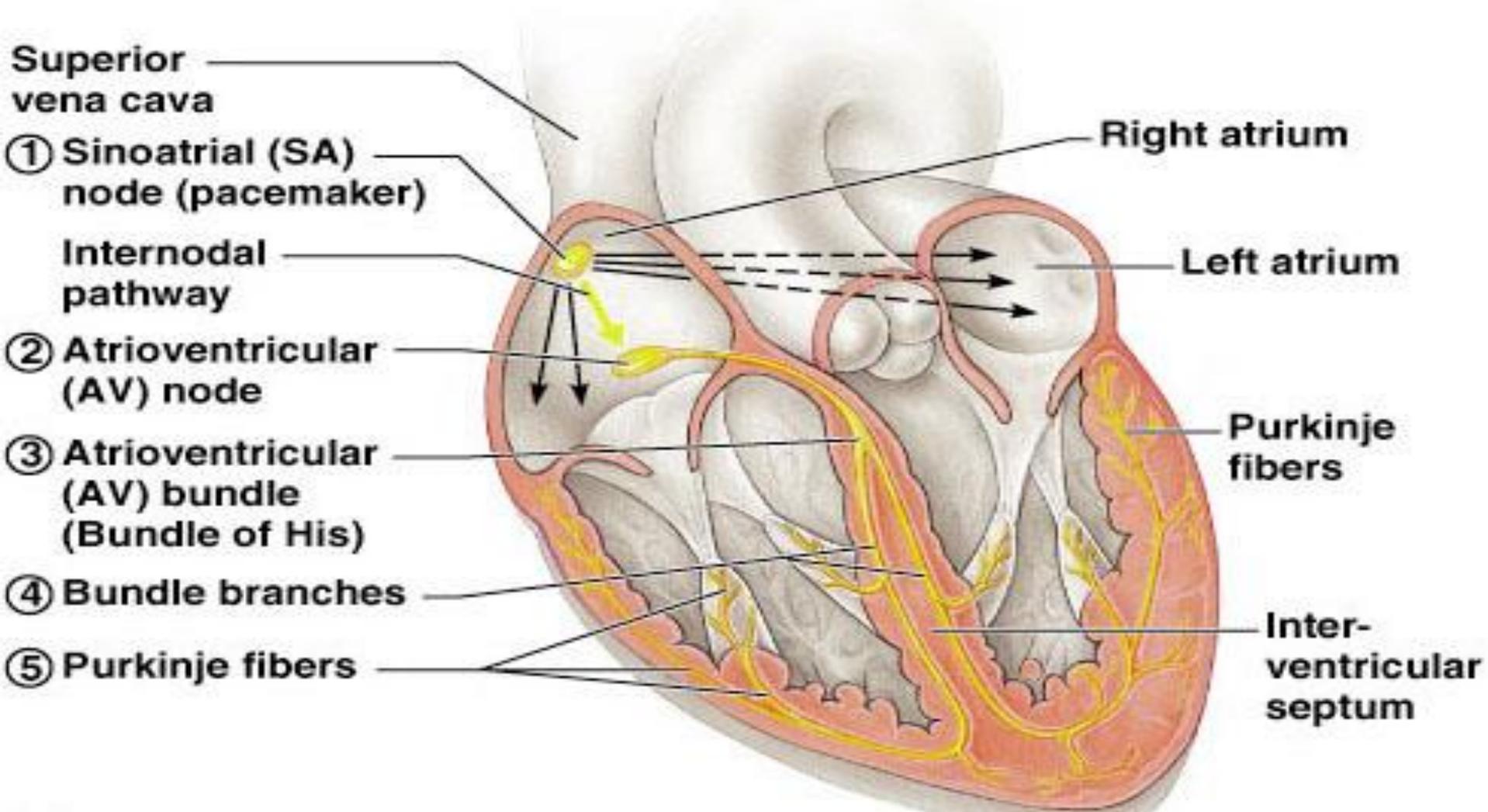
- ▶ Heart is stimulated by the sympathetic cardioaccelerator center
- ▶ Heart is inhibited by the parasympathetic cardioinhibitory center



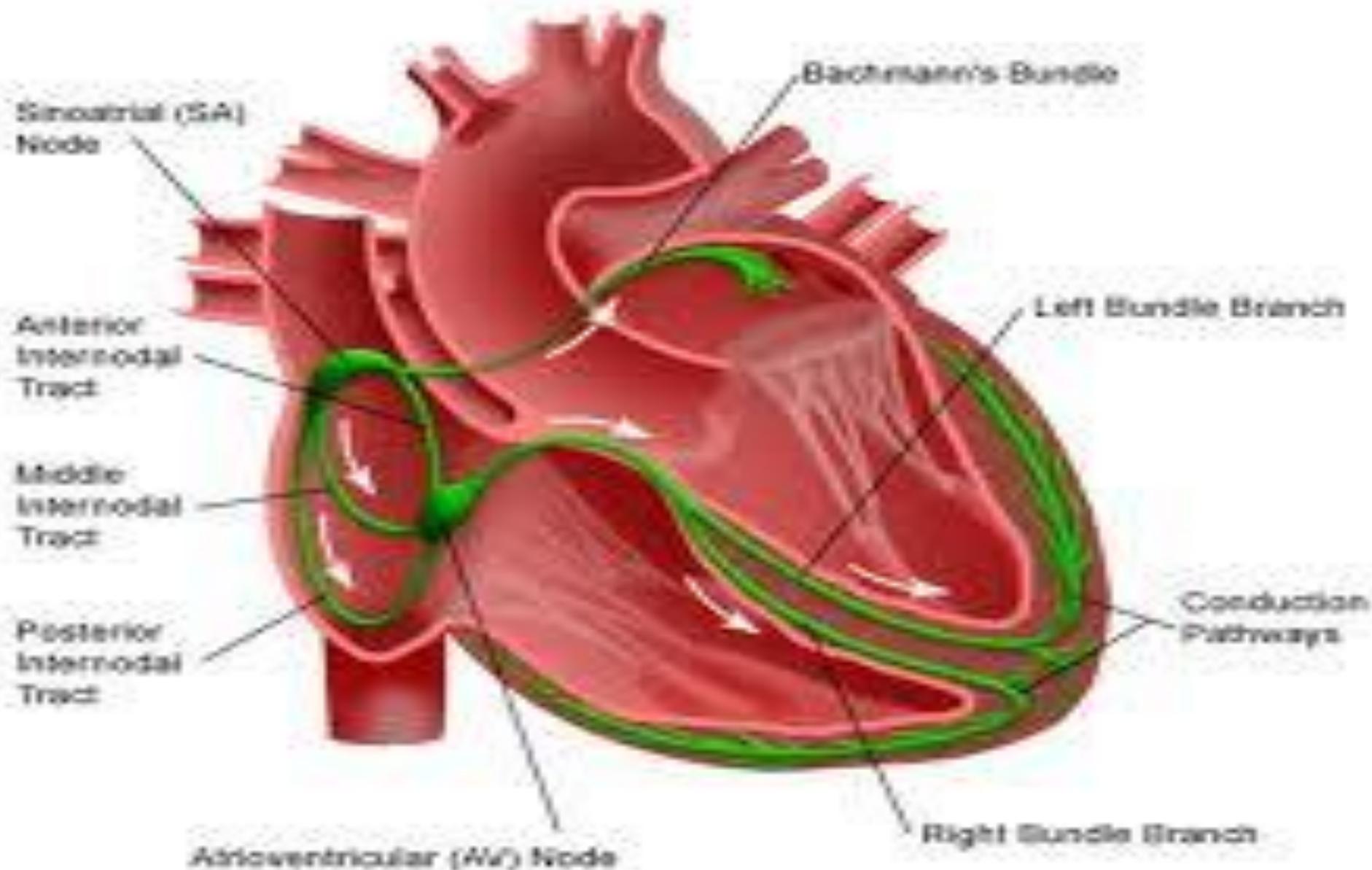
Heart Physiology: Sequence of Excitation

- ▶ Sinoatrial (SA) node generates impulses about 75 times/minute
- ▶ Atrioventricular (AV) node delays the impulse approximately 0.1 second
- ▶ Impulse passes from atria to ventricles via the atrioventricular bundle (bundle of His)
- ▶ **Heart Block** - the only route for impulse transmission from the atria to the ventricles is through the AV node, and damage to the AV node is called heart block

Heart Physiology: Sequence of Excitation



Electrical System of the Heart



Cardiac Arrhythmias

- Premature atrial contractions (PAC)
 - Seen in normal people with too much caffeine, anxiety, alcohol, electrolytes, vomiting or diarrhea
- Premature ventricular contractions (PVC)
 - Often seen in middle age and of no concern
 - Can also occur with MI, CHF, hypoxia
- Paroxysmal atrial tachycardia (PAT)
 - Usually in women 20-25
 - May be congenital and start in first year of life
 - Called Wolf Parkinson White Syndrome which requires a catheter radio-ablation

- Atrial fibrillation and flutter (AF)
 - Not life-threatening, yet it is a common cause of hospitalization
 - Causes the heart to be sporadically with no rhythmic pattern
 - May be caused by COPD, alcohol, cardiac surgery, hyperthyroidism, or idiopathic
 - The inefficiency of the atrial contraction leads to a potential buildup of clots in the wall of the atria
 - Treated with electrical cardioversion with anticoagulation meds
 - Some are resistant to cardioversion which puts them at risk for strokes, ventricular fibrillation and sudden death

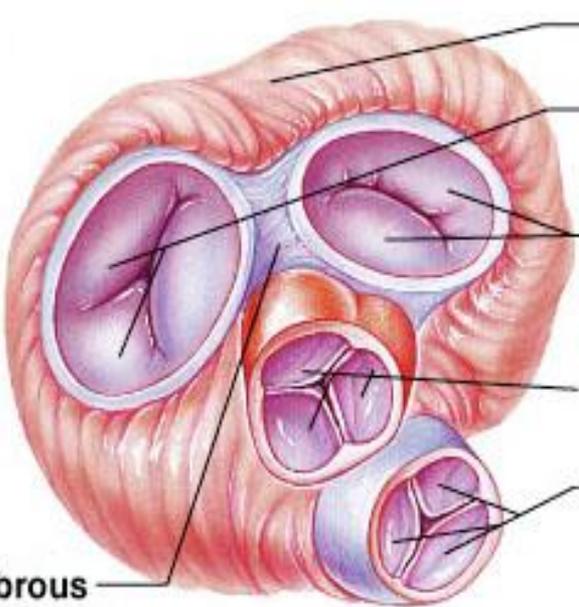
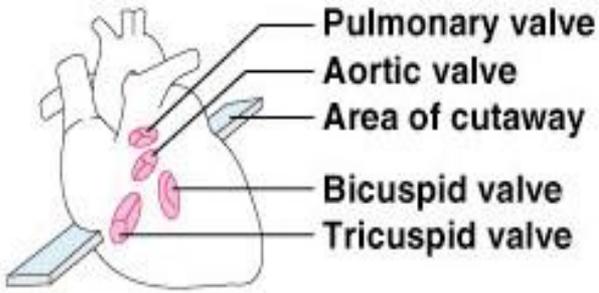
- Ventricular tachycardia (VT)
 - A normal response to exercise, stress reactions and sexual activity causing the heart to elevate up to 200/minute
 - In patient's with structural heart disease, VT can occur without provocation
 - S & S – pounding heart and lightheadedness
 - Treated with electrical cardioversion and beta blockers
- Bradycardia
 - Pulse less than 60/min or 46/min for athletes
 - Extrinsic causes by drugs, hypothyroidism, CNS disorders
 - Intrinsic causes by SA or AV node dysfunction
 - Treat the cause, such as a pacemaker

- Heart block
 - Often caused by ischemia due to CAD or may be idiopathic
 - Three degrees possible
 - 1st degree – impulses reach the ventricles and slow in the AV node – no treatment needed
 - 2nd degree – impulse slows so that not all beats get through the ventricle, causing bradycardia – may or may not need a pacemaker
 - 3rd degree (complete) – all impulses from the atria to the ventricles are blocked at the AV node – all need external pacemaker
 - Sick sinus syndrome - a wide variety of alternate bradycardia and tachycardia

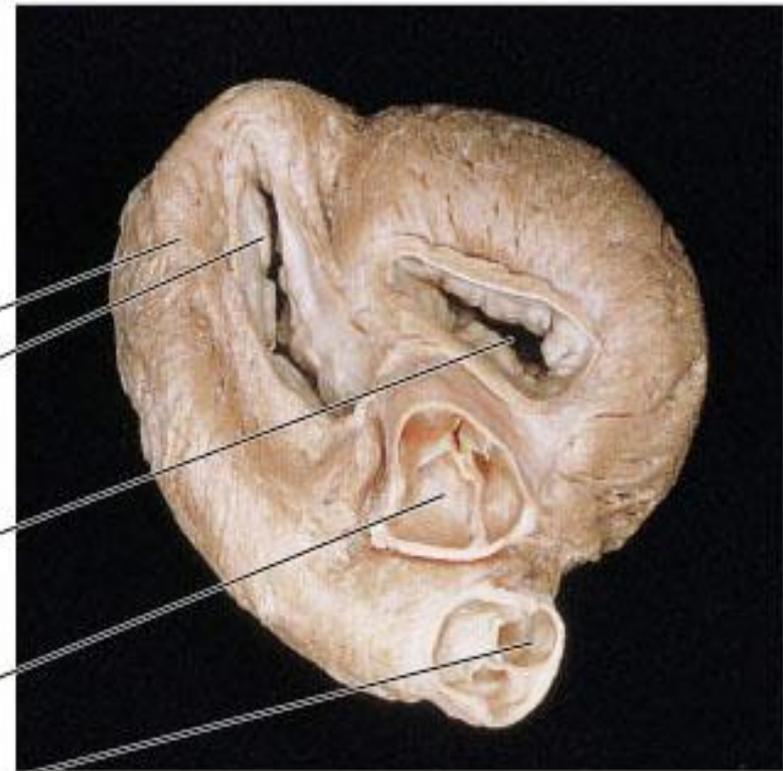
Cardiac Valve Disease

- Heart valve malfunction comes in two forms:
 - Valves that do not open well
 - This constricts the flow and is called stenosis
 - Valves that do not close well
 - This causes backwards leakage and is called regurgitation or insufficiency
- Four most common valve problems
 - Mitral regurgitation
 - Aortic regurgitation
 - Mitral stenosis
 - Aortic stenosis

Heart Valves



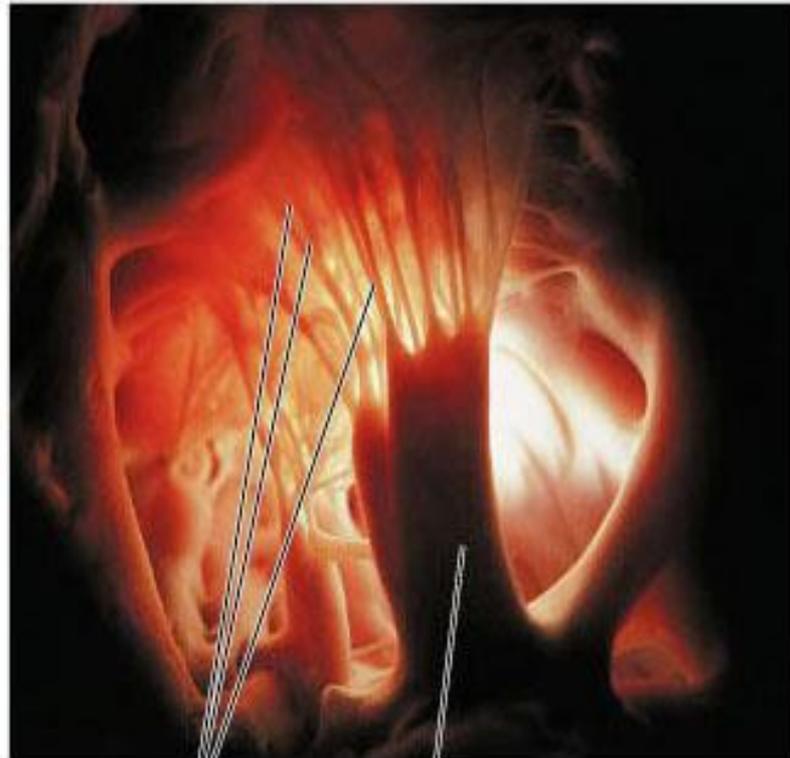
- Myocardium
- Tricuspid valve (right atrioventricular)
- Bicuspid (mitral) valve (left atrioventricular)
- Aortic semilunar valve
- Pulmonary semilunar valve



(b)

(a)

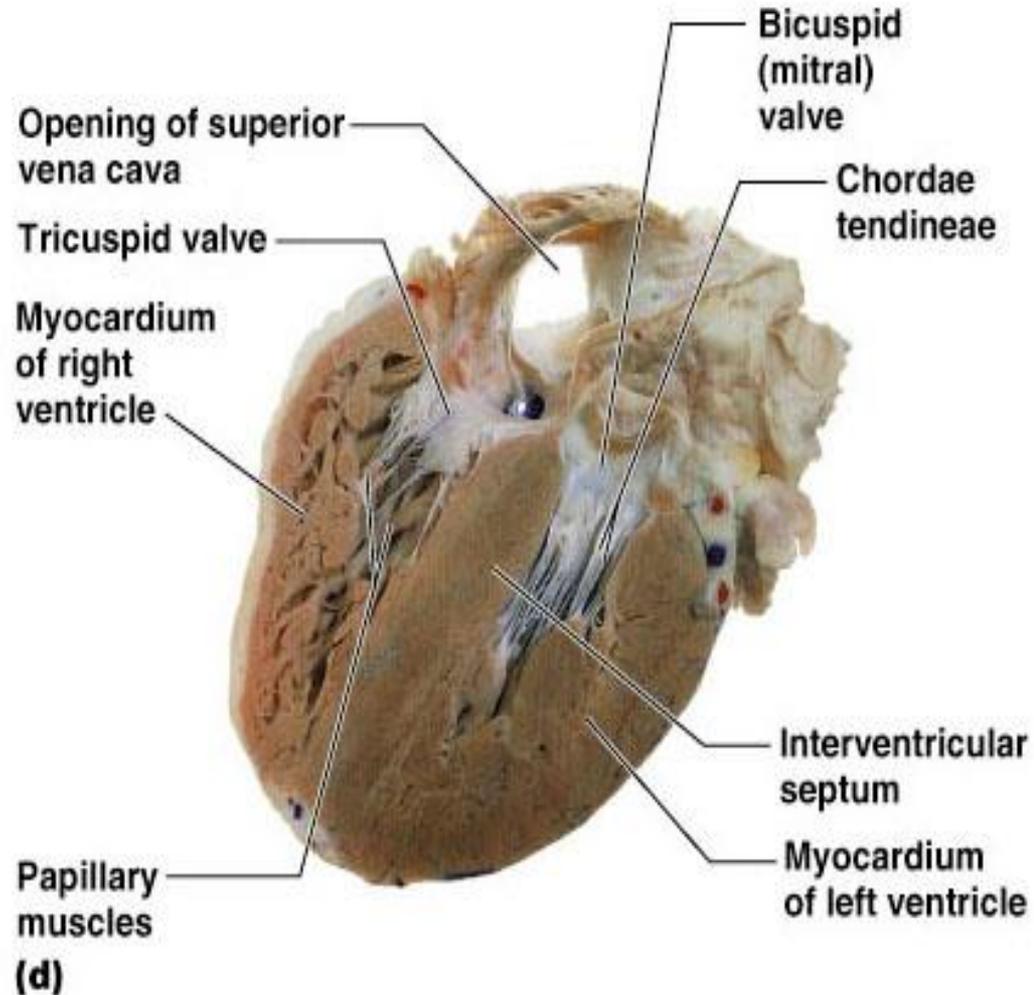
Heart Valves



Chordae tendineae attached to tricuspid valve flap

Papillary muscle

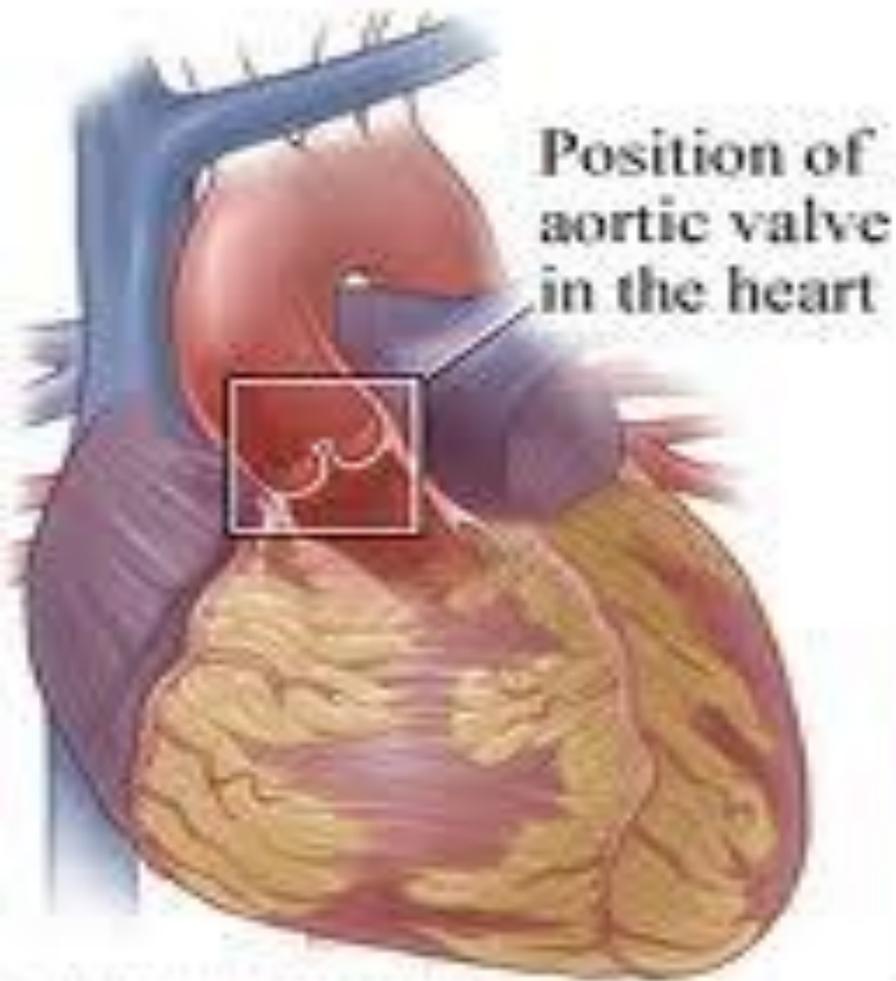
(c)



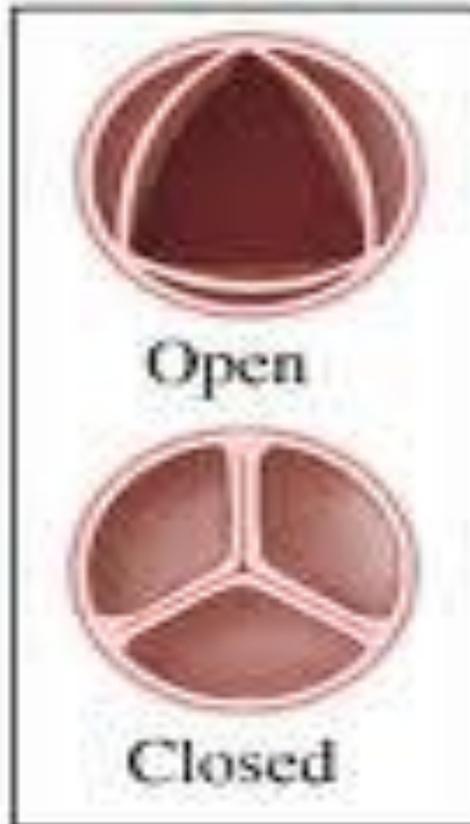
(d)

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

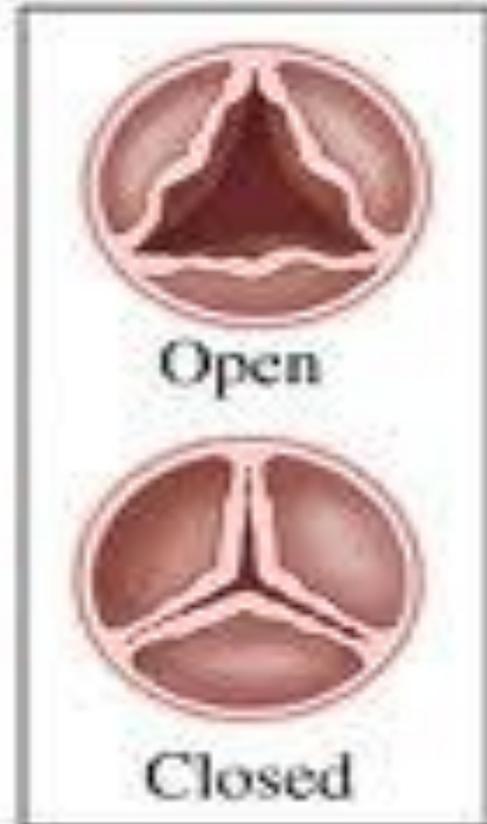
Valve Stenosis

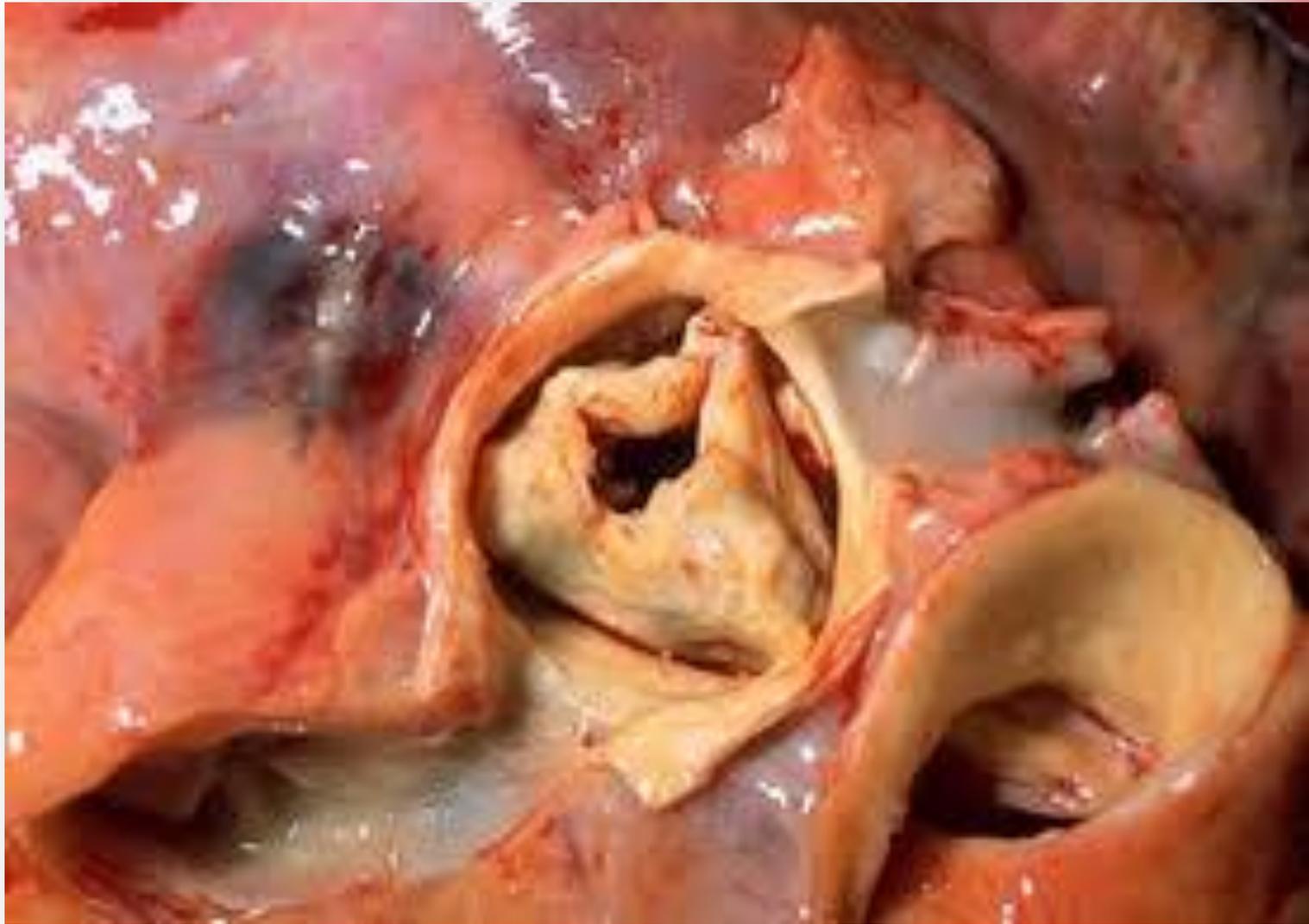


Normal aortic valve



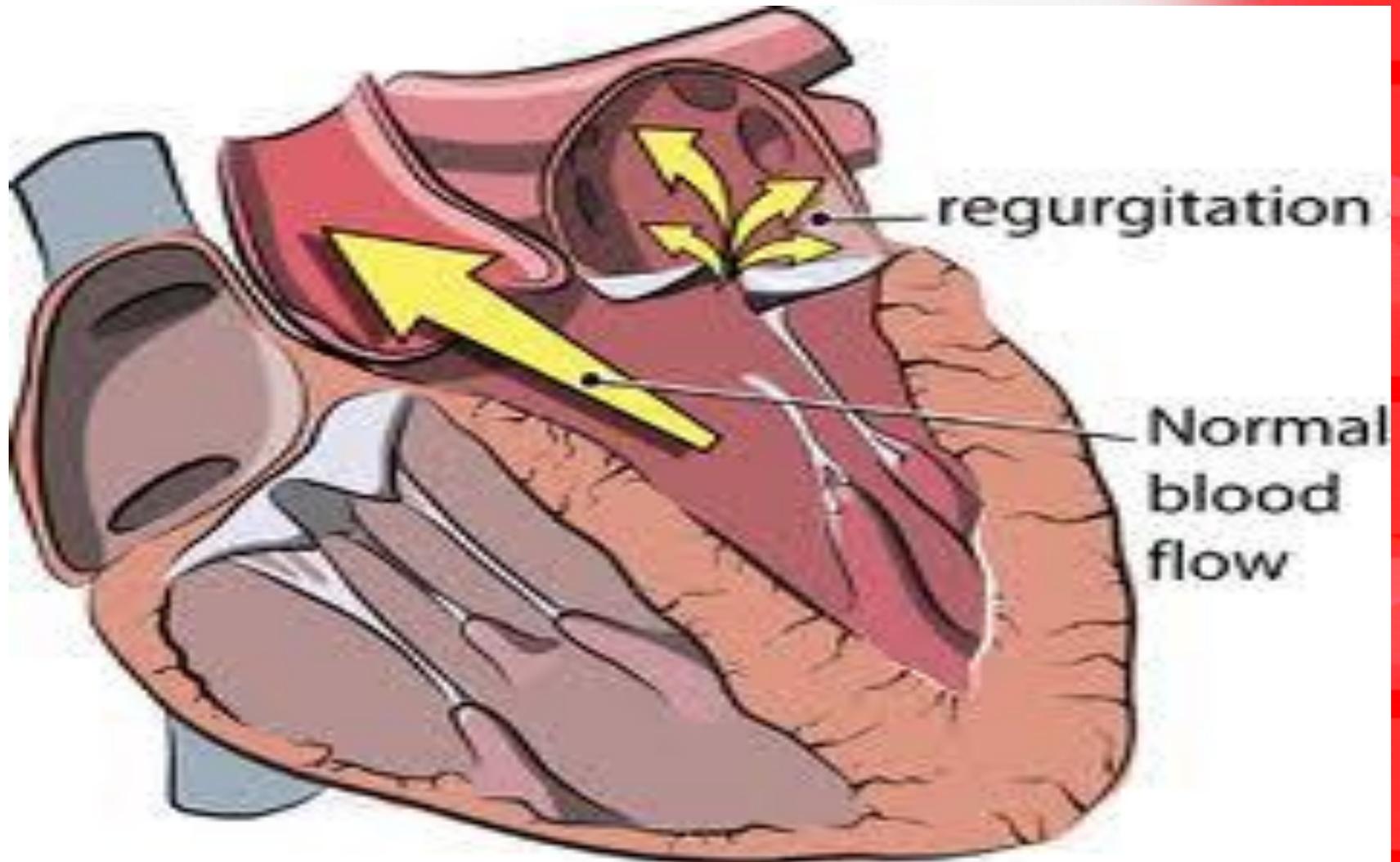
Aortic valve stenosis







Valve Regurgitation

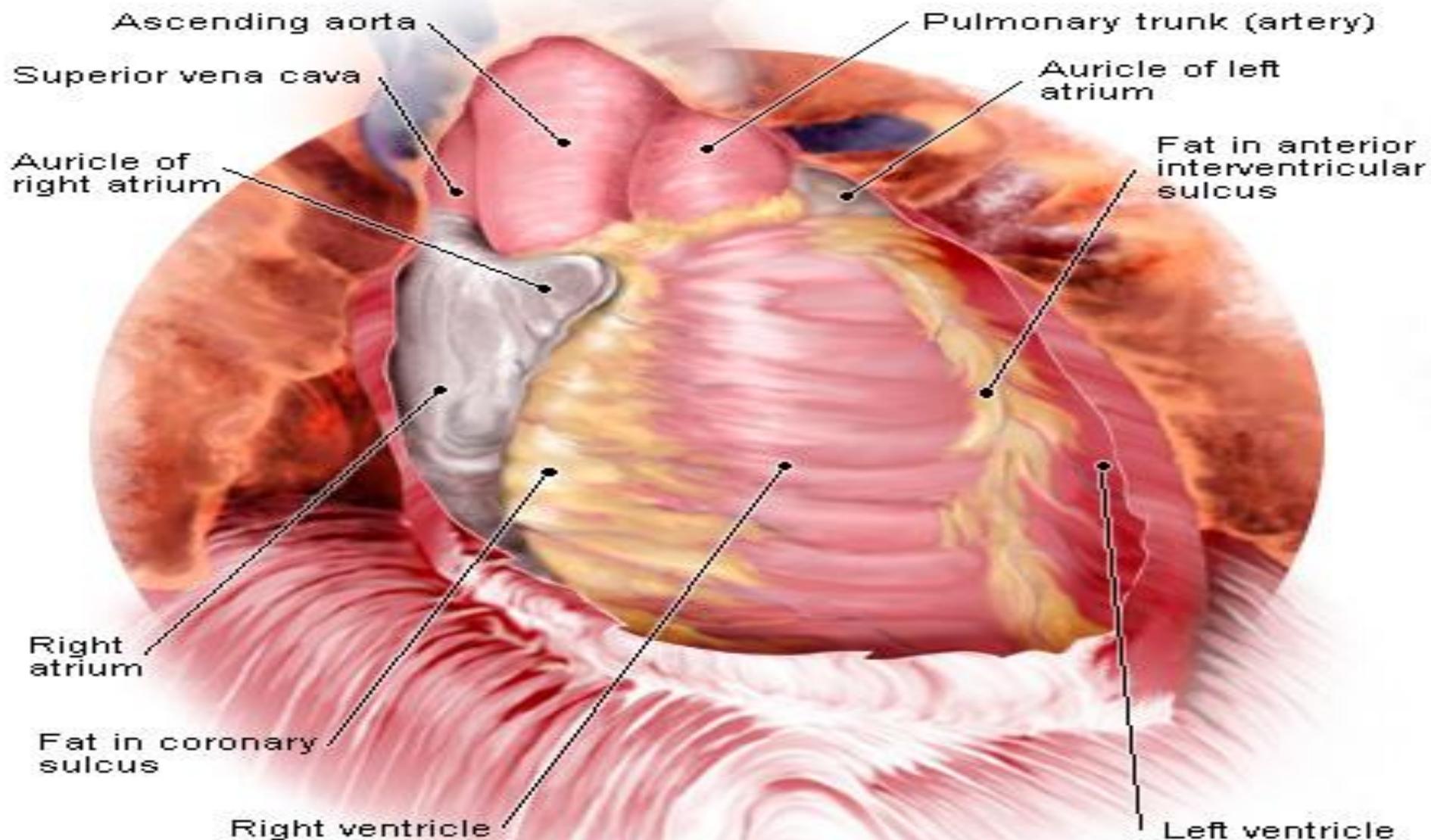


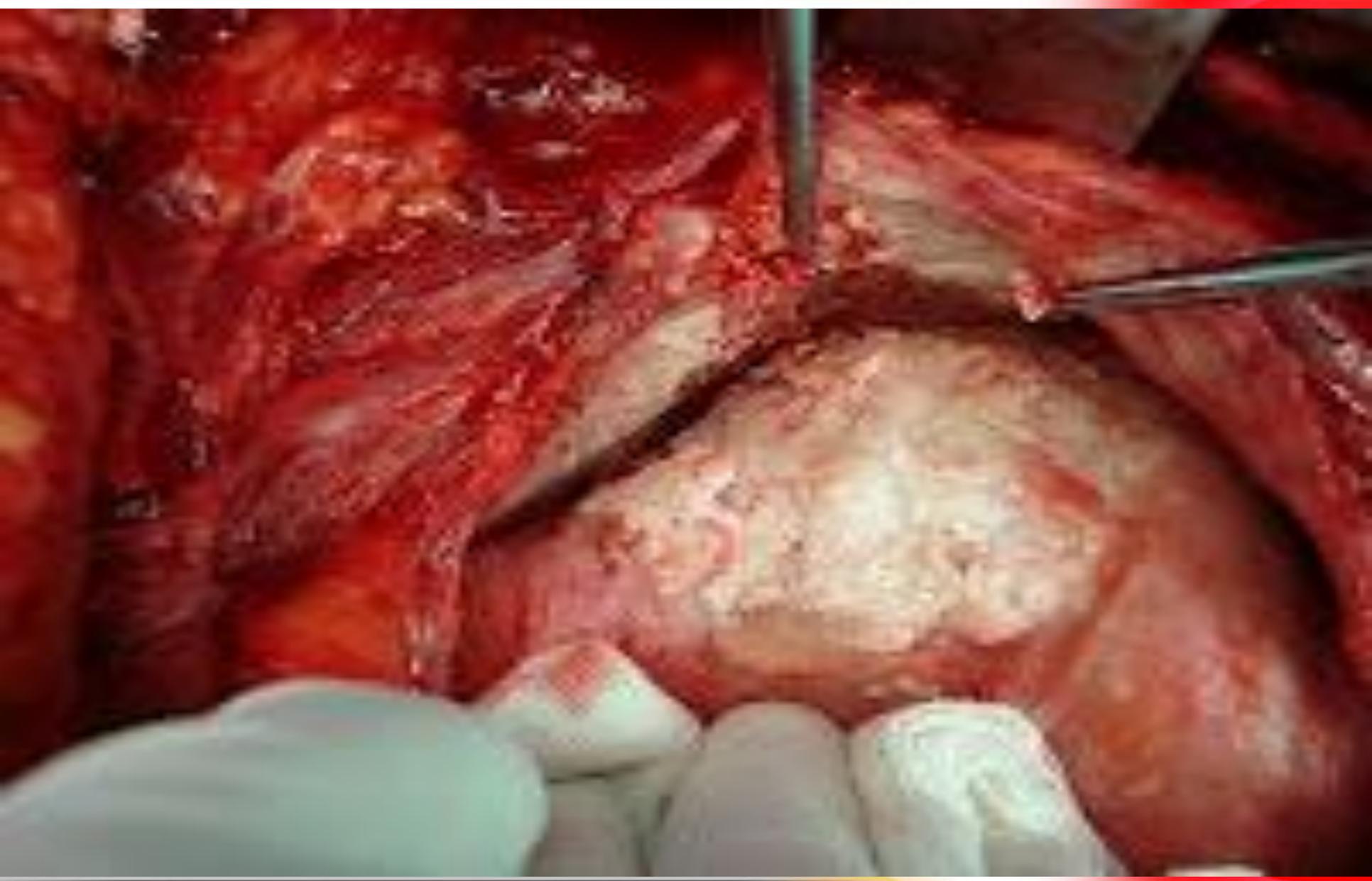
Pericarditis

- Has a triad of chest pain, ECG changes and **pericardial friction rub** – the patient must have 2 of the 3 to make the diagnosis
- Major causes
 - Viral infections, myocardial infarction, drug side effect, connective tissue disorders, blunt or penetrating trauma
- S & S
 - Chest pain radiating to back or left shoulder
 - Fatigue or dyspnea
- Diagnosis
 - High intensity friction rub and ECHO

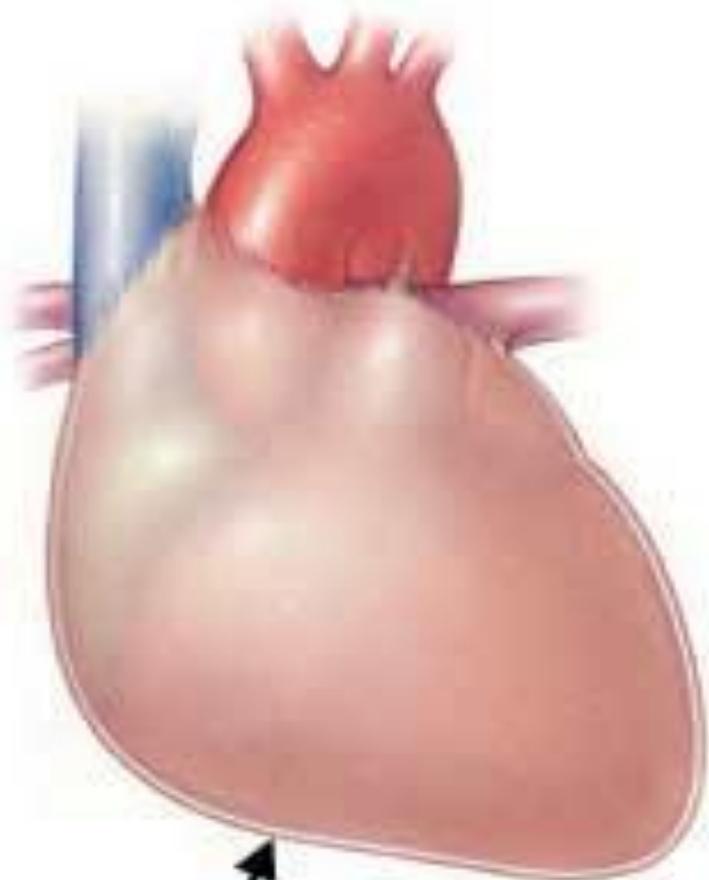
- Treatment
 - NSAIDs and steroids
 - Pericardiocentesis to avoid cardiac tamponade from effusion
 - Tamponade is fatal if not relieved
- Prognosis
 - Most resolve in four weeks
 - Some cases become chronic which require surgery to remove the thickened constrictive heart layer

Heart in the Pericardial Sac



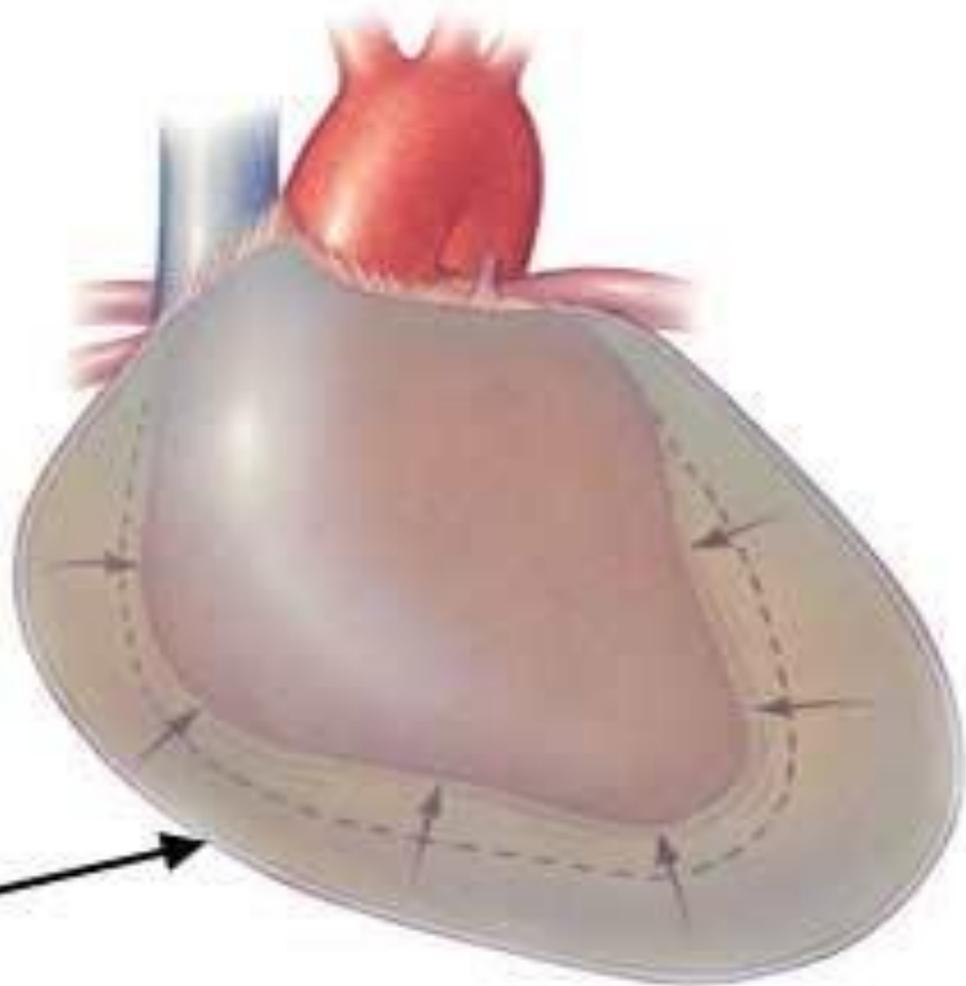


Normal pericardium



Pericardial sac

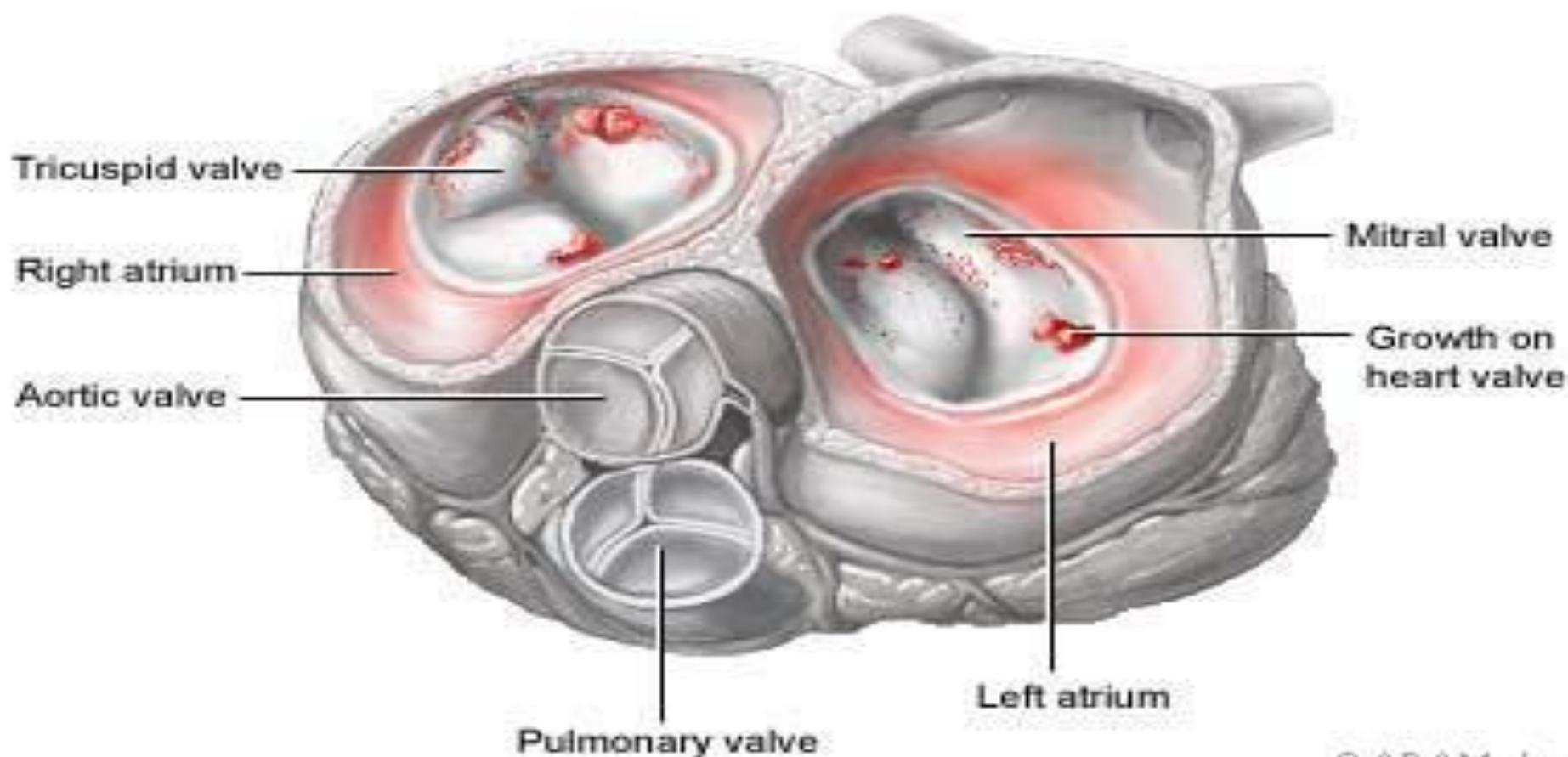
Pericardial effusion



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*)
 - 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



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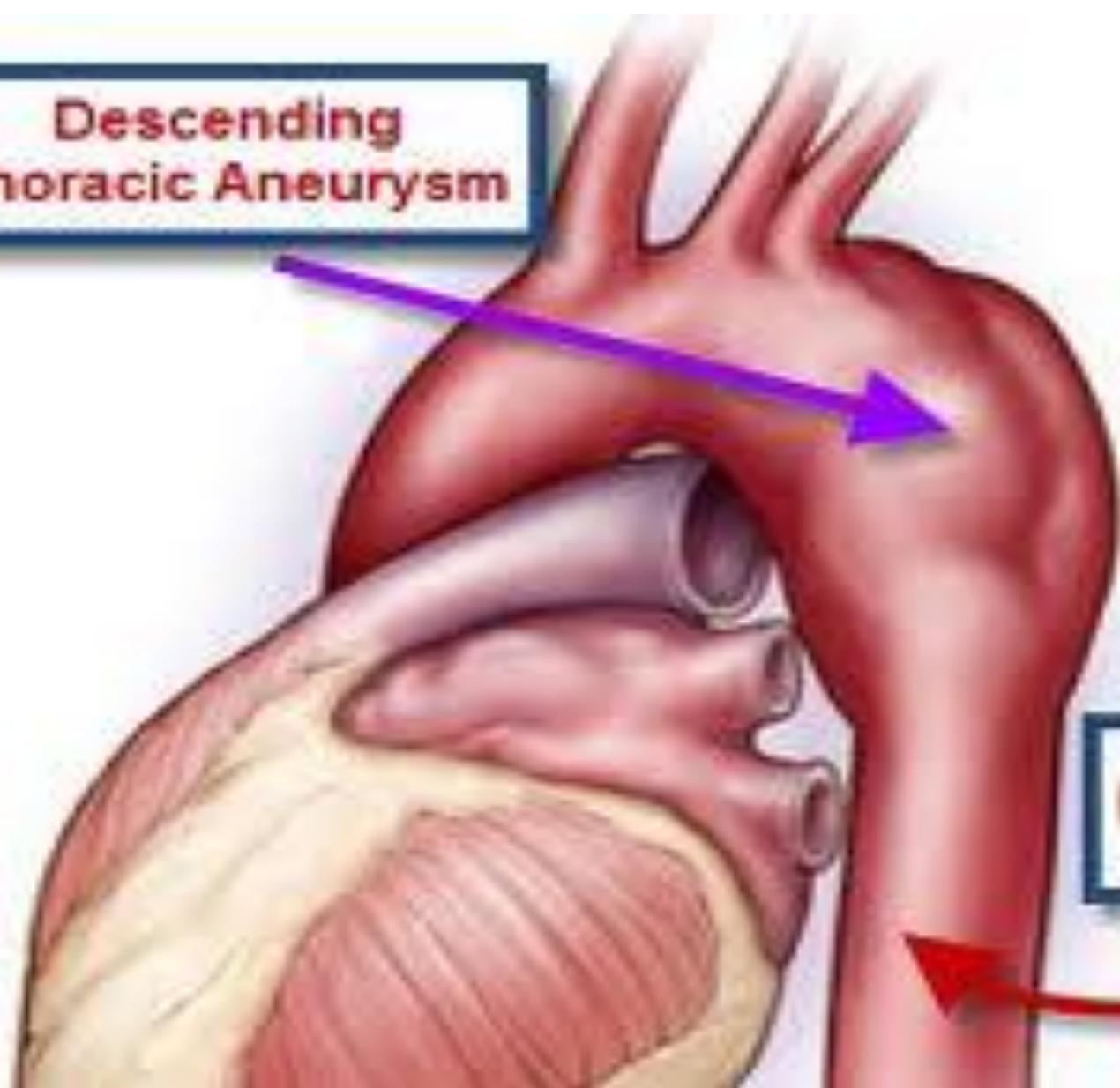


Aortic Artery Disease

- Ruptured aortic aneurysms are responsible for 15,000 deaths per year (half die in surgery)
 - (> 4 cm diameter with normal at 2.5 to 3 cm)
- S & S
 - Often no symptoms when they are small
 - When they enlarge, they cause low back pain and powerful abdominal pulse sensation
- Diagnosis
 - Pulsating aneurysm palpated and seen on ultrasound
- Treatment
 - Surgical resection > 5 cm diameter

**Descending
Thoracic Aneurysm**

Normal Aorta





Peripheral Artery Disease

- Arteriosclerosis
 - Generalized narrowing and stiffening of arteries occurring over 65 year years old
- Atherosclerosis
 - The process of plaque formations over the age of 35
 - Plaques build up where vessels split and can lead to strokes, gangrene and heart attacks
 - Very common in diabetes
 - Risk factors
 - Tobacco (3-4X), age, HTN, diabetes, cholesterol, sedentary lifestyle, high homocysteine

- S & S
 - Blood flow restricted to lower extremities
 - Severe claudication
 - Sharp pain with exercise that stops with lack of movement
- Diagnosis
 - Diminished or absent peripheral pulses
 - Doppler flowmeter changes
 - Ischemic limbs have purple-red color
 - Glove-like distribution of nerve loss
- Treatment
 - Vasodilators
 - Vascular surgery

Normal artery

Mild atherosclerosis

Severe atherosclerosis

