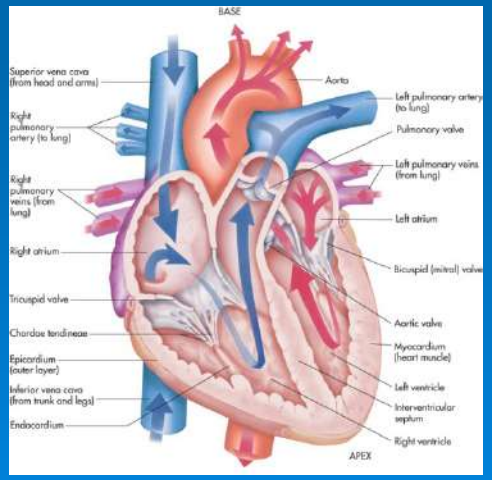
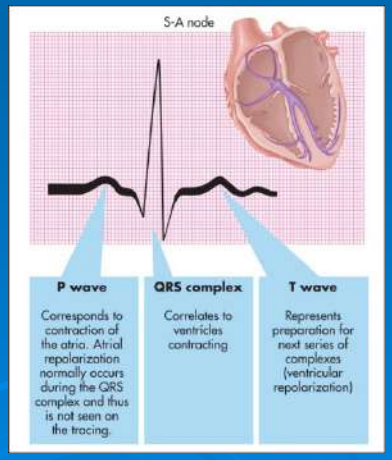
Health Sciences & Occupations

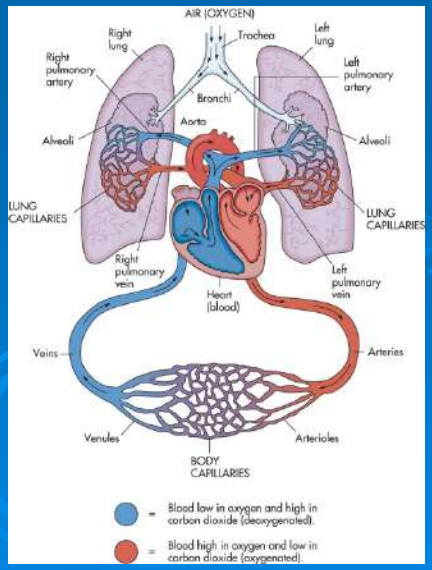
Anatomy, Physiology and Disease

Chapter 12

The Cardiovascular System



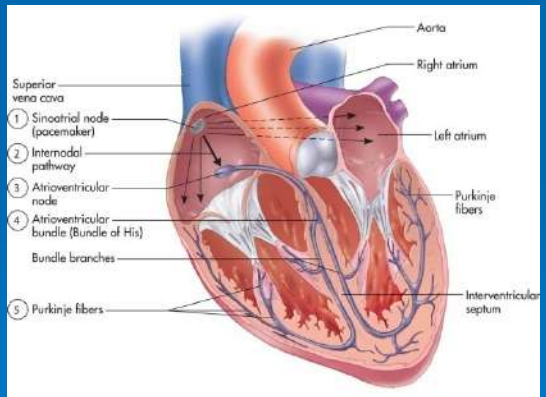




Introduction

Cardio-vascular system

- Transports nutrients & oxygen to cells in body while carbon dioxide and waste products of cells' metabolism are removed.
- Pump that circulates the transport medium (blood) is the heart.



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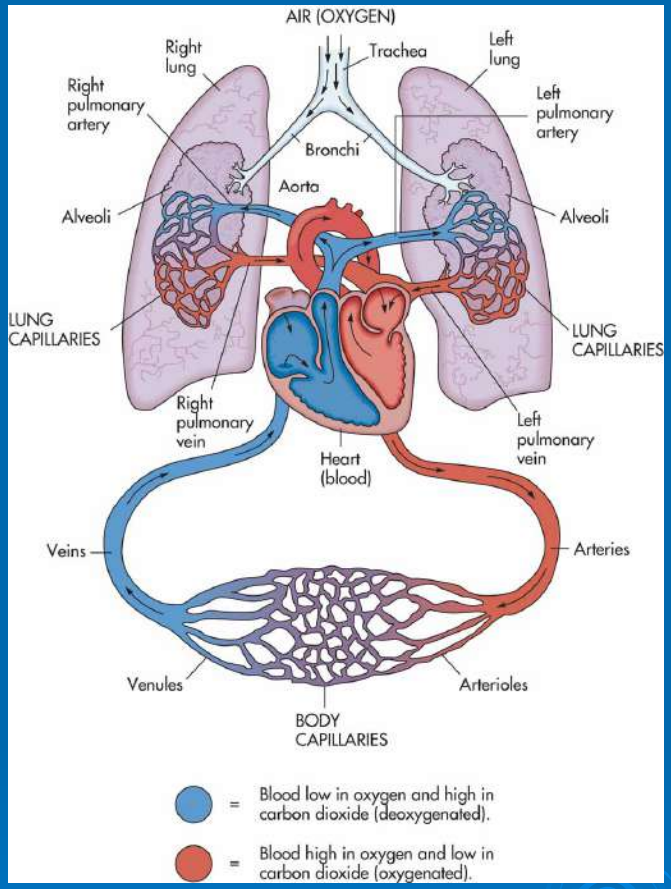
System Overview

- Components include heart, blood, and network of blood vessels.
- Arteries carry blood away from heart, branch into smaller vessels called arterioles, which become capillaries, where nutrients are exchanged; capillaries become venules, that enlarge and become veins.



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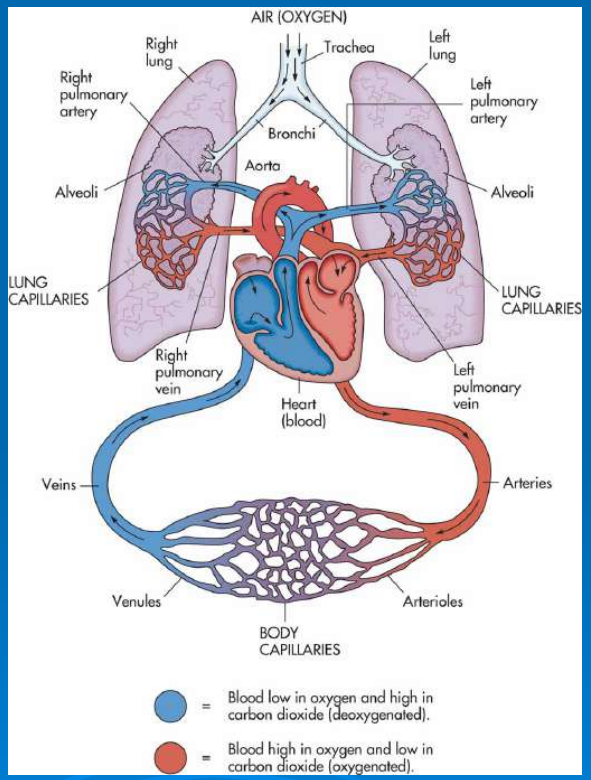
System Overview con't

- Veins differ from arteries because they carry blood toward heart, have valves, and have thinner walls.



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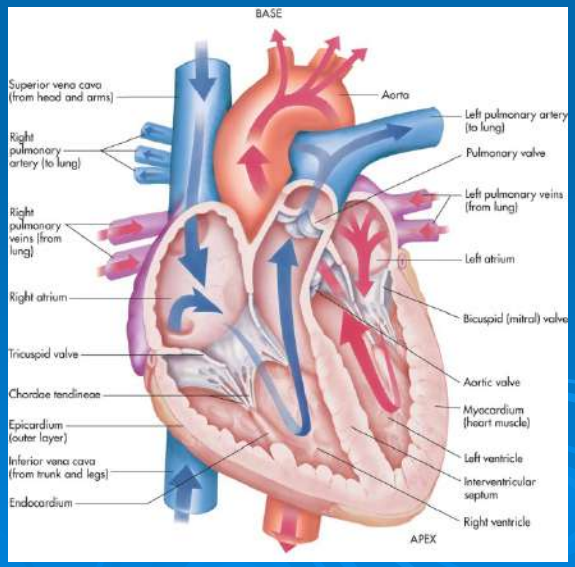
The Heart

- Size of your fist: located slightly left of center of chest.
- Base is proximal to your head while apex is distal.
- One single organ but with two pumps working together.
- Right side collects blood from body and sends it to lungs; left side collects blood from lungs and sends it to rest of body.



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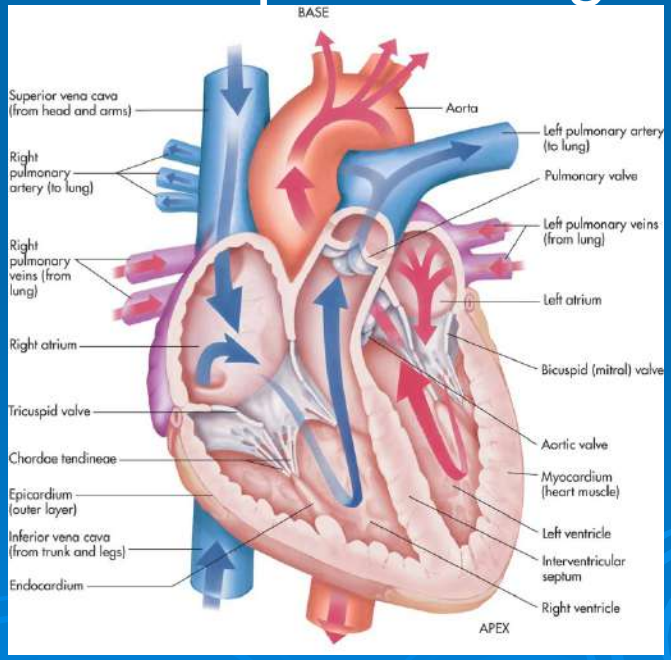
Four Chambers in Heart

Septum: seperates heart in right & left half

- Interatrial Septum: seperates right Atrium from left Atrium.
- Interventricular Septum: seperates right & left ventricles.



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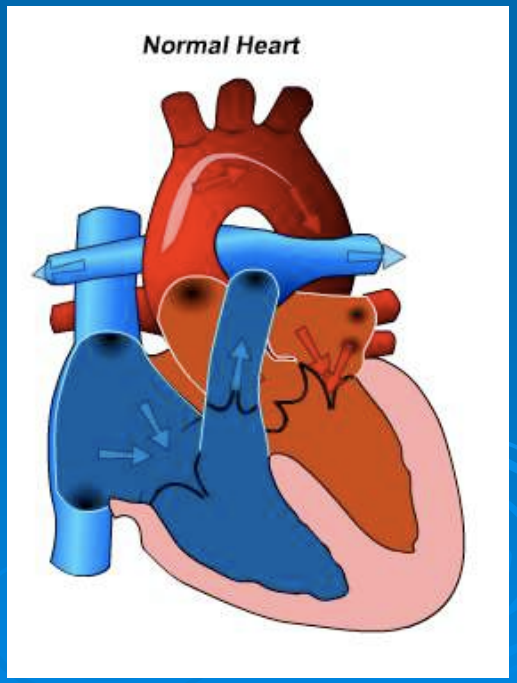
Chambers of the Heart con't

- Right Atrium: collecting chamber where blood is returned to heart after trip around body.
- Superior & Inferior Vena Cavae: large veins return blood to right atrium.
- Tricuspid Valve (atrioventricular): directs blood from rt. Atrium to rt. Ventricle.



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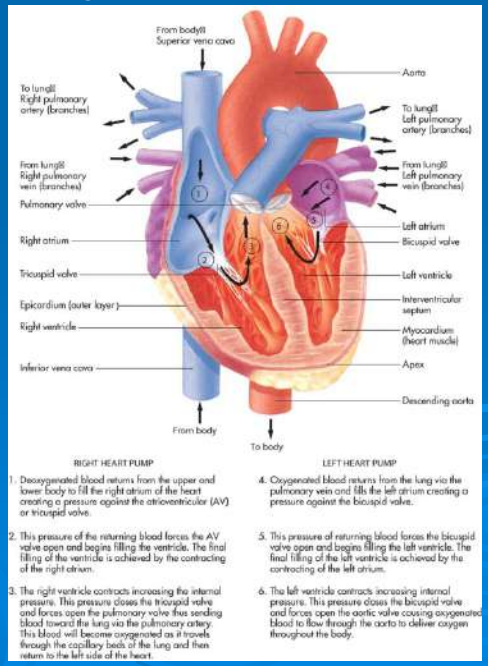
Chambers of the Heart con't

- Heart contraction occurs: when rt. Ventricle is full of blood.
- Tricuspid valve prevents backflow of blood into rt. Atrium.
- Blood flows through pulmonary semilunar valve to "*pulmonary arteries*."



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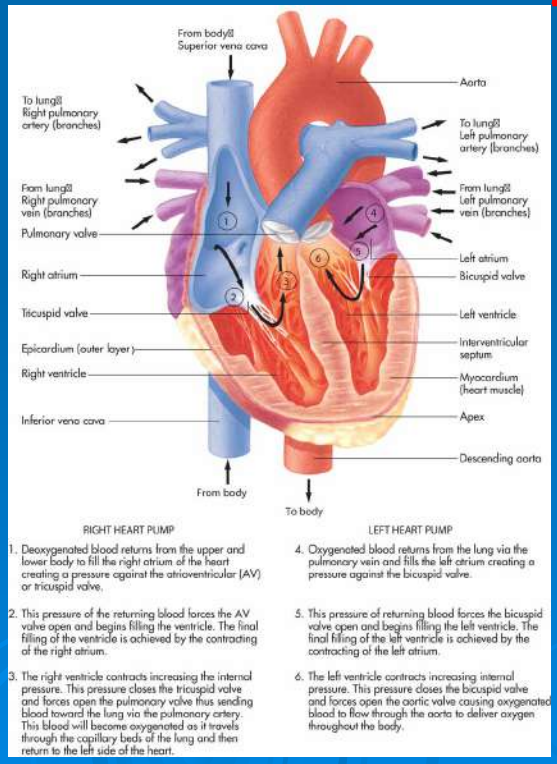
Chambers of the Heart con't

- Rt. & Lt. "*pulmonary arteries*" goes to lungs where vessels get smaller and smaller, ending in capillaries around each air sac (alveolus)
- Blood returns to Lt. Atrium via "*pulmonary veins*."



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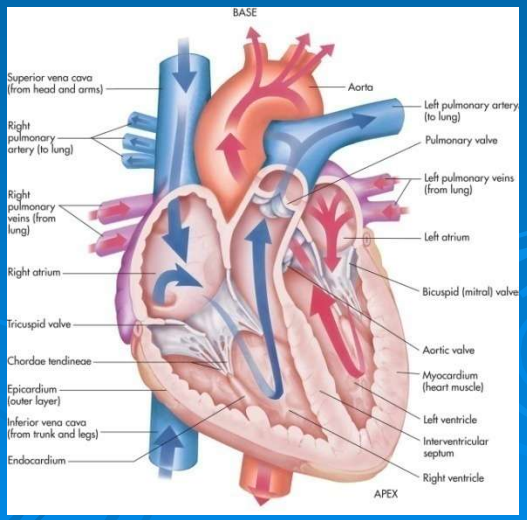
Chambers of the Heart con't

- Mitral Valve (Bicuspid Valve): allows blood flow from Lt. Atrium to Lt. Ventricle.
- Left ventricular pressure increases as it fills
- Heart contracts forcing mitral valve (Bicuspid Valve) closed.
- Blood is ejected through aortic semilunar valve to ascending aorta, and then out to rest of body.



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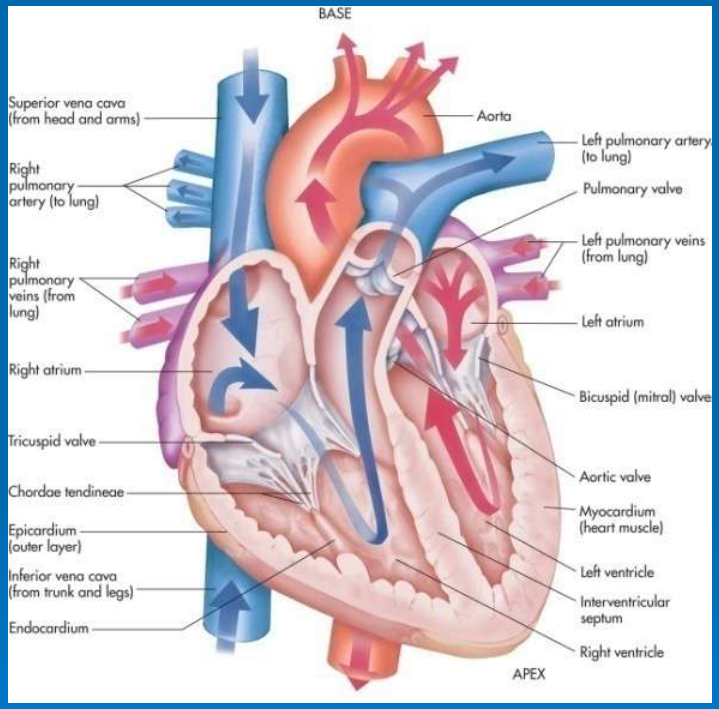
The Route of an RBC



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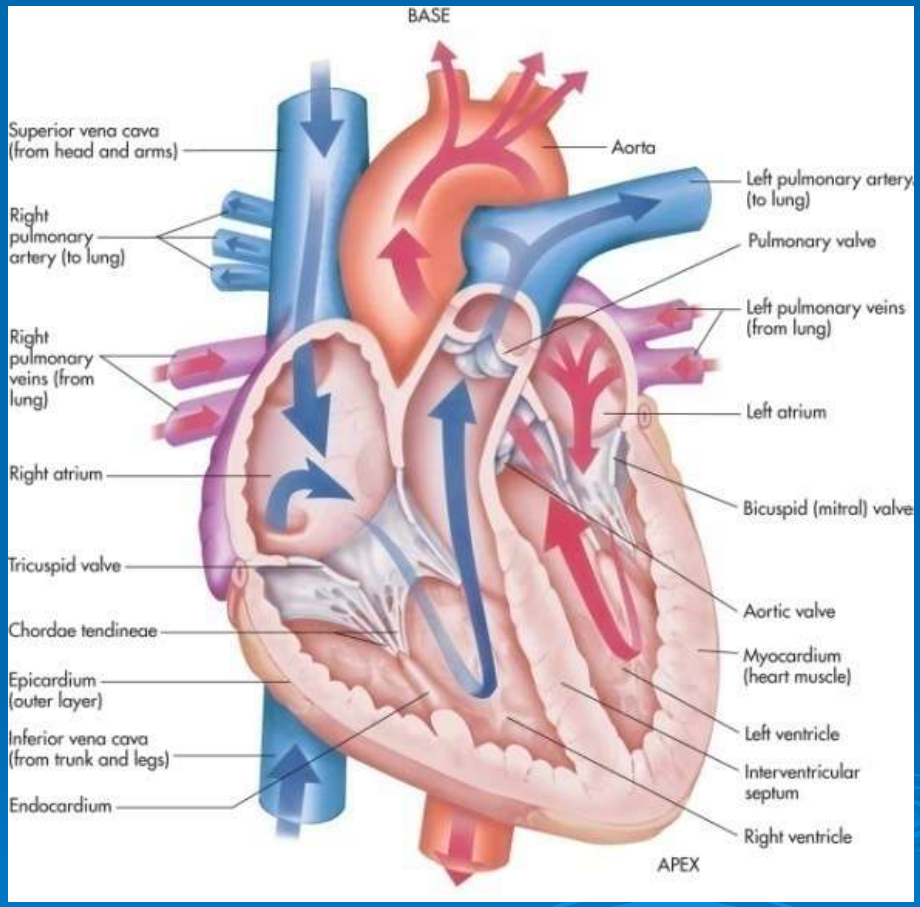
The Route of an RBC

Superior/Inferior vena cava
Right Atrium
Tricuspid valve
Right Ventricle
Pulmonary Valve
Pulmonary Artery
Lungs
Pulmonary Veins
Left Atrium
Bicuspid Valve
Left Ventricle
Aortic Valve
Aorta



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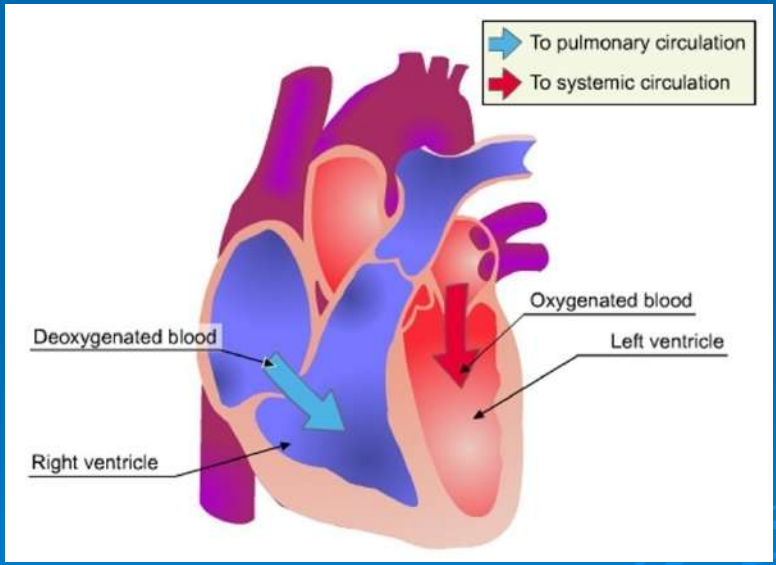
Chambers of the Heart con't

- Systole: contraction phase when blood is ejected from the ventricles.
- Contraction: begins at apex and travels upward
- Diastole: resting period when chambers refill with blood.



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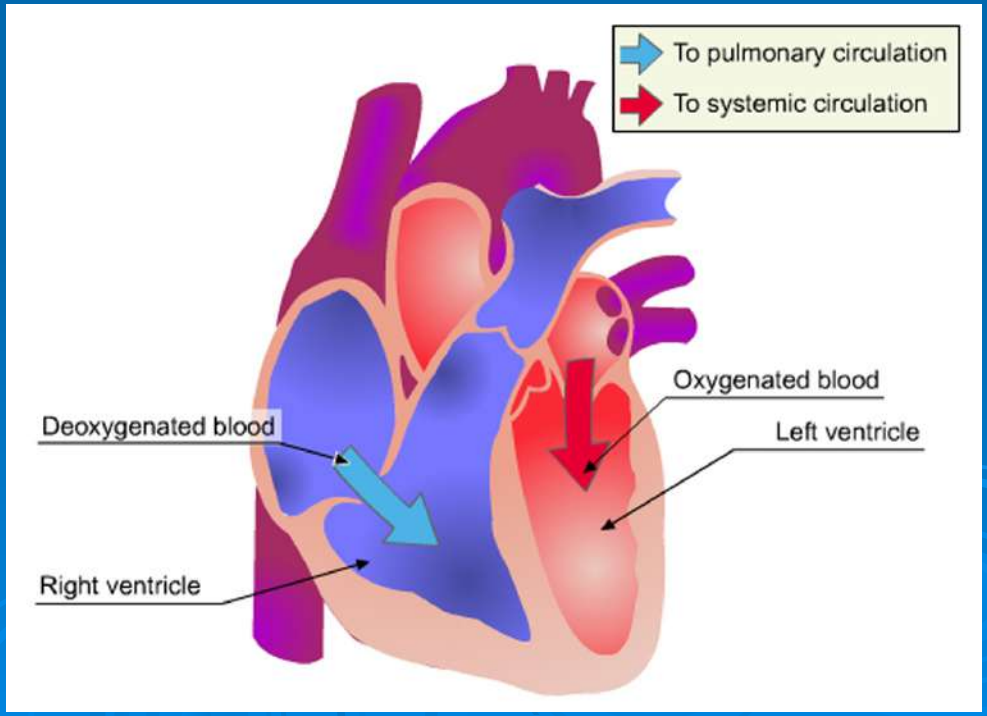
Chambers of the Heart con't

- Atrial walls: thinner than ventricular walls

Ventricular walls:

- Lt. ventricle pumps blood to body thus thick walls
- Rt. Ventricle pumps blood to lungs thus thinner walls.



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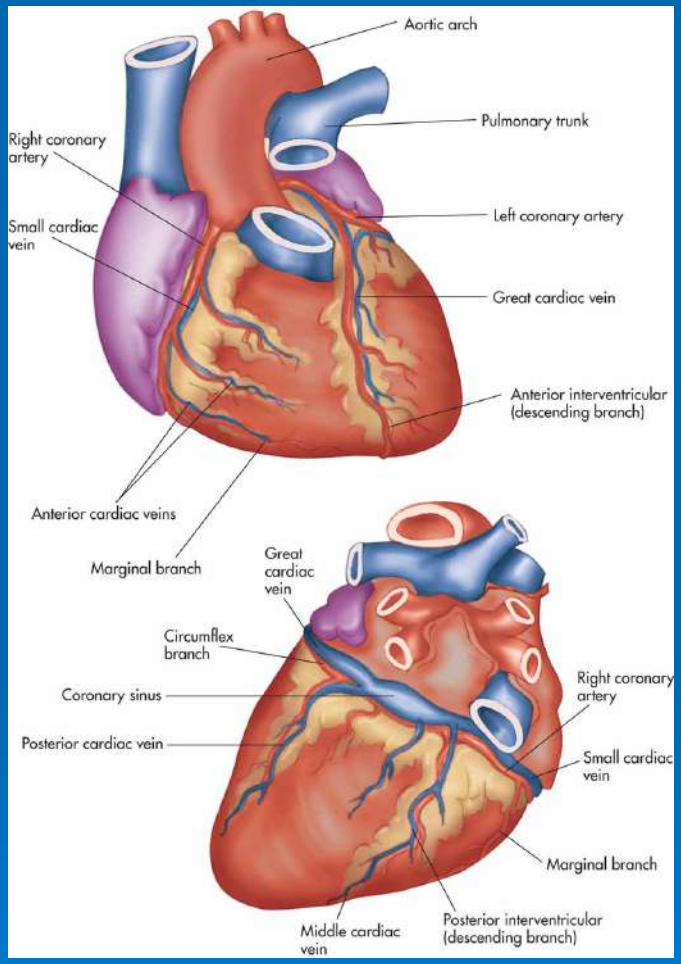
Coronary Arteries



Right coronary artery: provides blood for right ventricle, posterior portion of interventricular septum, and inferior parts of heart.

Left coronary artery: provides blood to left lateral and anterior walls of left ventricle, and portions of right ventricle and interventricular septum.

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Pathology Problems (CHF)

- Rt. Side Heart Failure:(cor pulmonale)

Etiology: muscles chronically work harder than normal resulting in large muscle & inefficient pumping; pulmonary embolus, COPD.

S/S: SOB, wheezing, engorged liver & spleen, ankle, feet & hand edema, & JVD (distended neck veins)

Dx: Chest X-ray

Rx: O2, diuretics, digitalis, nitrates, thrombolysis

End Of Slide

Heart Failure (CHF)

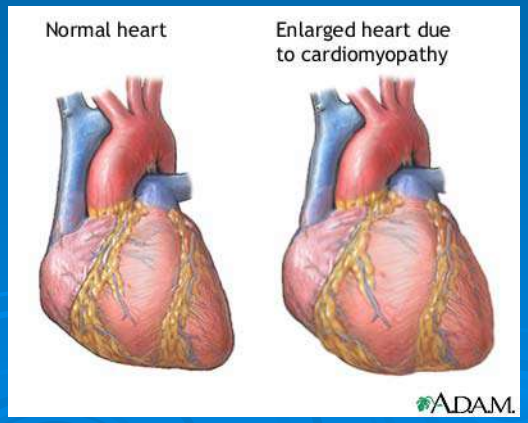
- Formally called Congestive Heart Failure (CHF)

Etiology: heart cannot move blood efficiently. Pump cannot overcome resistance in blood vessels.

S/S: enlarged liver, spleen, JVD, swelling of feet, ankles, and/or hands. Dyspnea, SOB, chest pain, hypoxia.

Dx: CXR, ABGs (arterial blood gases)

Rx: diuretics, digitalis



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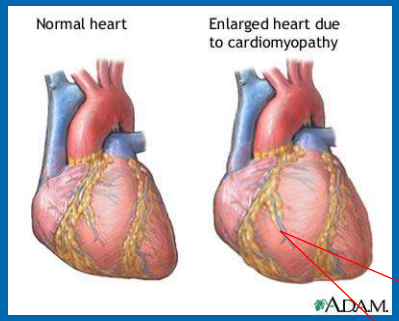
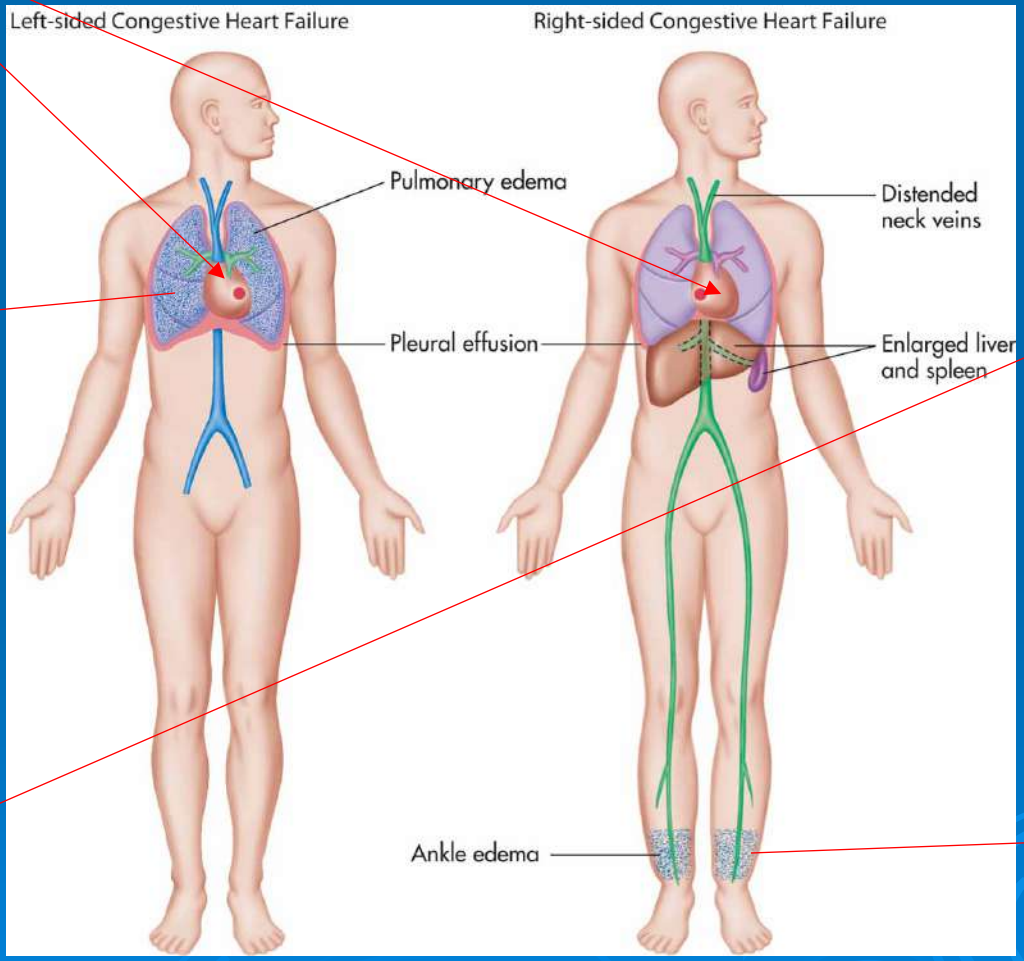
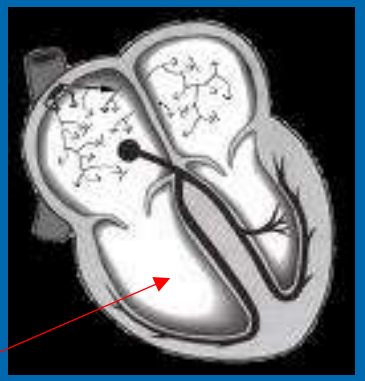
Rt & Lt CHF







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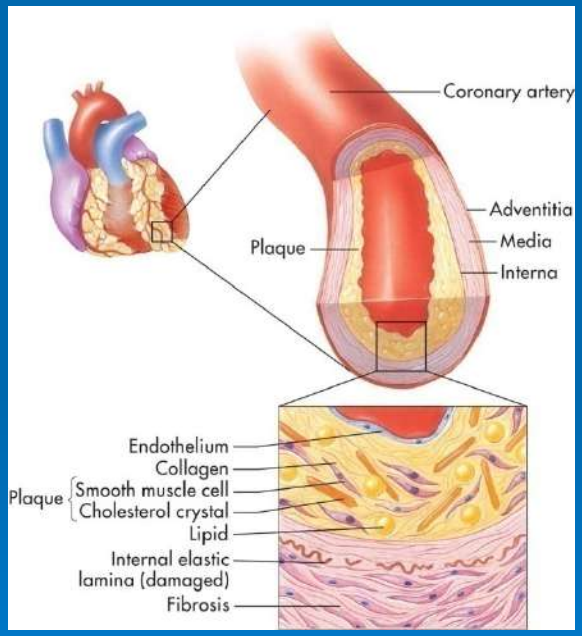
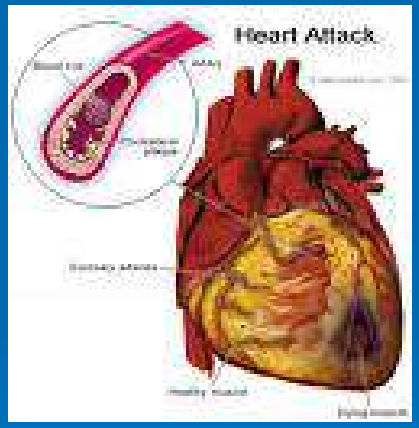
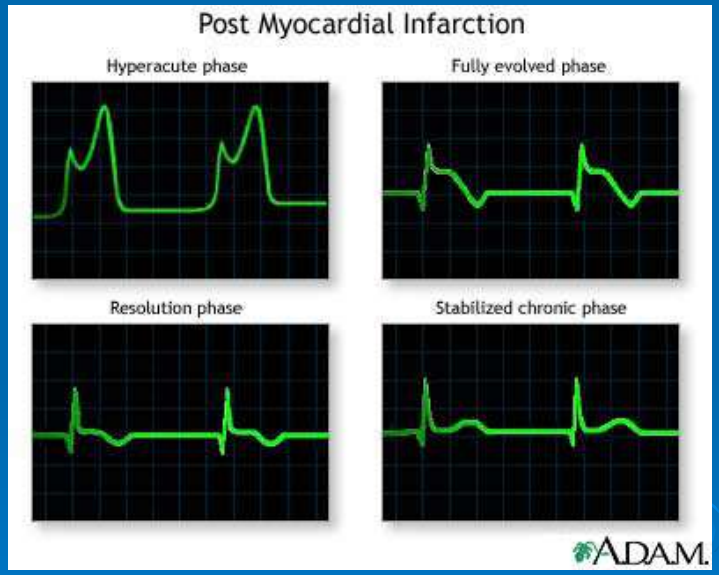
Myocardial Infarction (MI)

Etiology: Infarct: tissue damage & death that results from completely blocked blood flow from blood clot in coronary blood arteries (coronary thrombosis)







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Myocardial Infarction (MI) Cont'd

S/S: CP or heaviness, pain to Lt. shoulder, arm or jaw; N/V, weakness, SOB, clammy-sweaty feeling, dizziness, anxiety, "indigestion."

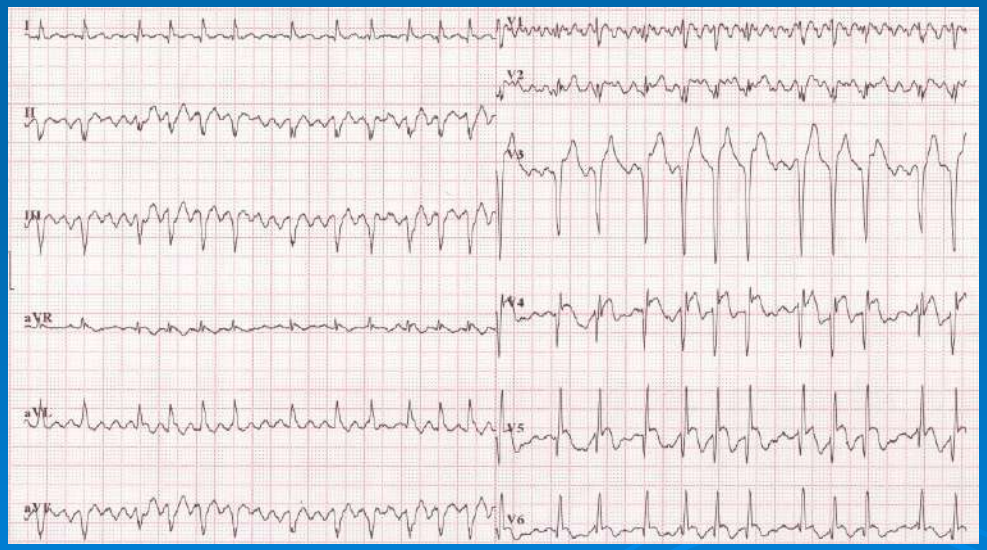
Odd S/S: little or no pain; called silent MI, women exhibit "non-traditional" s/s like jaw pain.

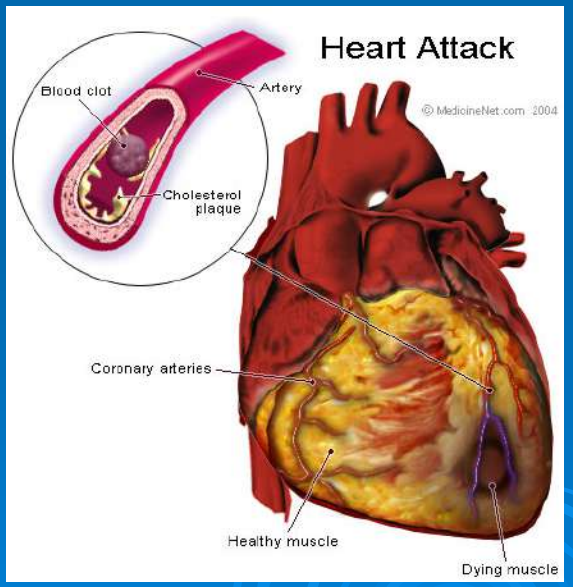
Dx: EKG, CXR, ABGs, CK-MB & Troponin blood tests.

Rx: ASA 162mg PO, O2, sublingual NTG , MS (morphine sulfate IV), anticoagulants Heparin or clotbusters

Measurements used to diagnose MI

- CK-MB: enzyme creatine kinase in heart muscle cells, can be detected in blood within 2-6 hours post MI.
- Troponin: increases in blood approximately 4-6 hours after MI





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Causes of MI

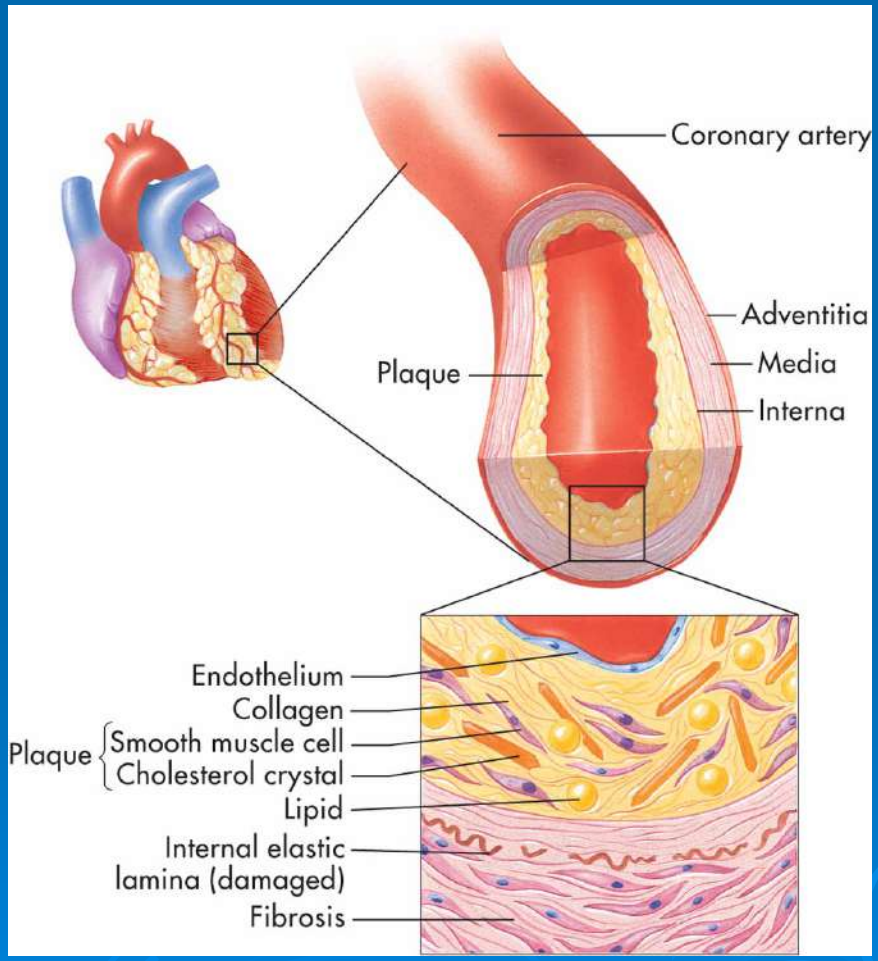
Arteriosclerosis:

- Thickening of inner layer (“hardening”) of arteries
- Vessels become less flexible or brittle, increasing risk of rupture & likelihood of hypertension.

Atherosclerosis:

- Fatty deposits called plaques build up on inner lining of blood vessels.
- Plaque of cholesterol; build up can block blood flow
- Risk Factors: heredity; diabetes; diet and lifestyle

Atherosclerosis



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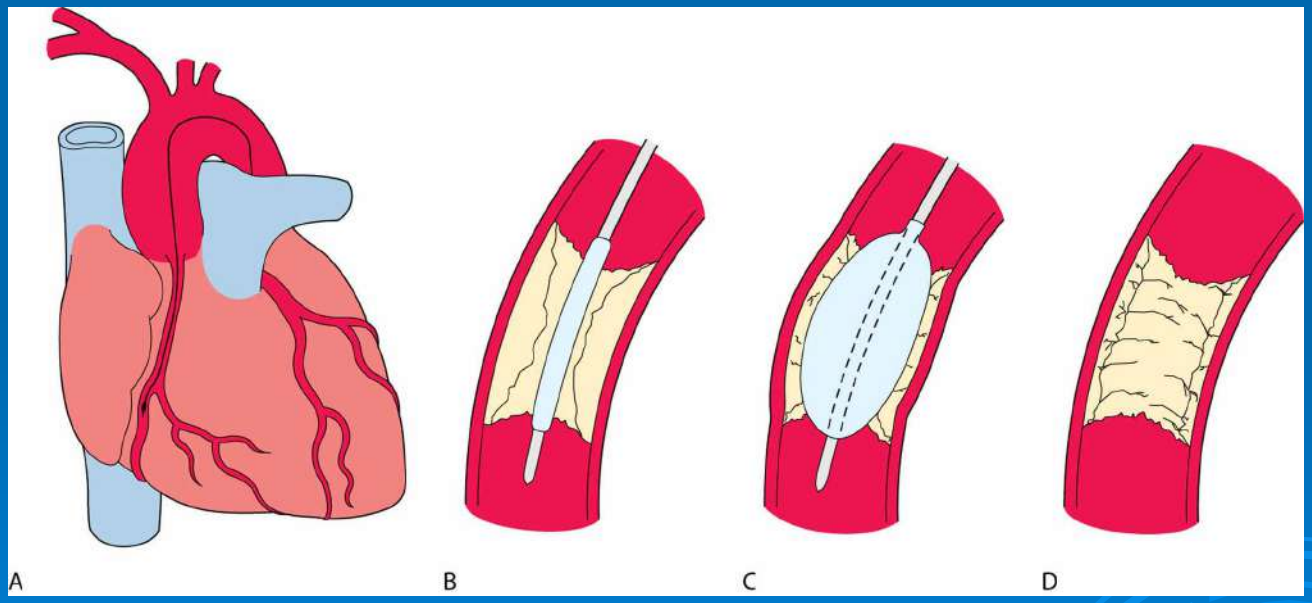
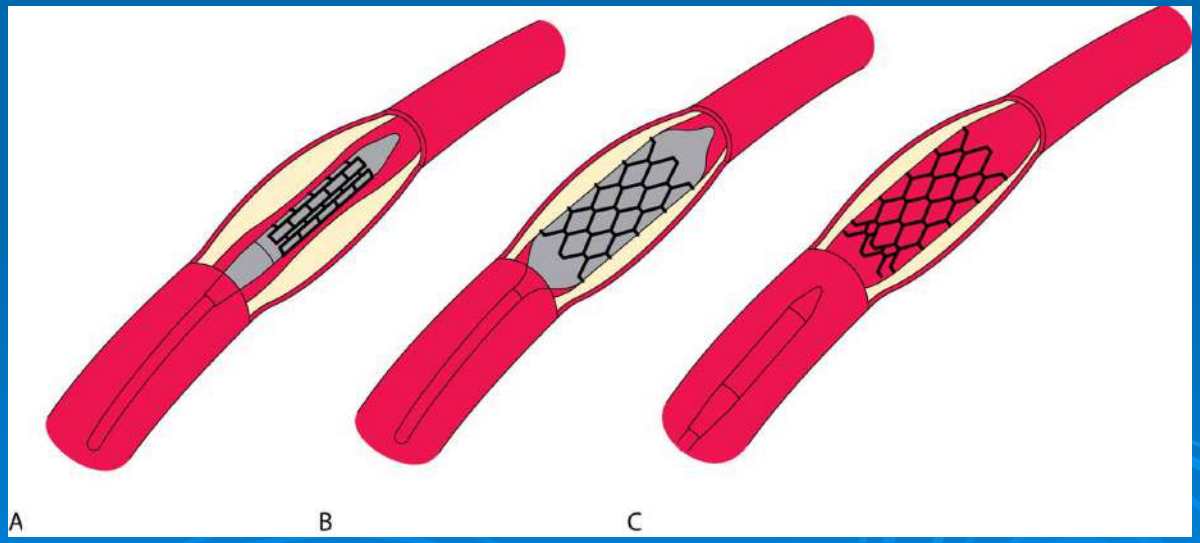
Rx for Atherosclerosis

- Coronary Angioplasty: balloon-tipped catheter threaded up to large plaque; balloon is inflated, squishing plaque to side & increasing blood flow.



Rx for Atherosclerosis 2 of 3

- Intracoronary stent placement: stents are wire devices that hold blood vessel open after angioplasty; can prevent re-occlusion of blood vessel.



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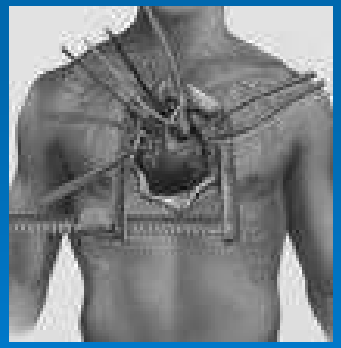
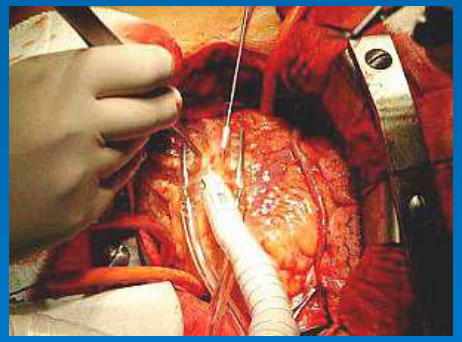
Rx for Atherosclerosis 3 of 3

- Coronary artery bypass graft (CABG): surgical procedure where healthy blood vessels from another part of body are used to replace clogged coronary arteries.





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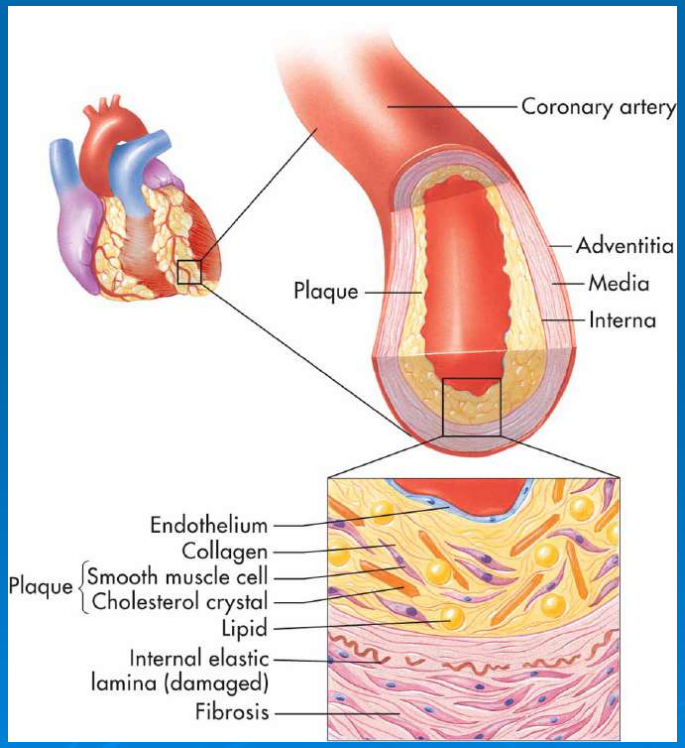
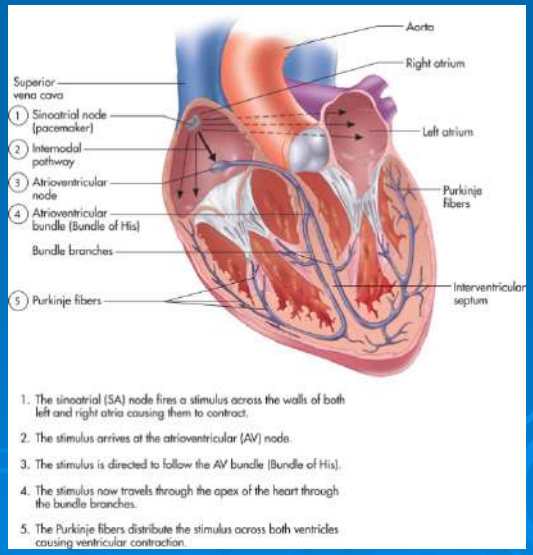
The Heart's Electrical System

- Cardiac muscle is autorhythmic
- Specialized cardiac cells that create & distribute electrical current that causes myocardial contractions.



Nodal Cells, or Pacemaker Cells

- Specialized cells that not only create electrical impulse, but create impulses at regular interval.
- Divided into 2 groups, Sinoatrial (SA) node & Atrioventricular (AV) node.



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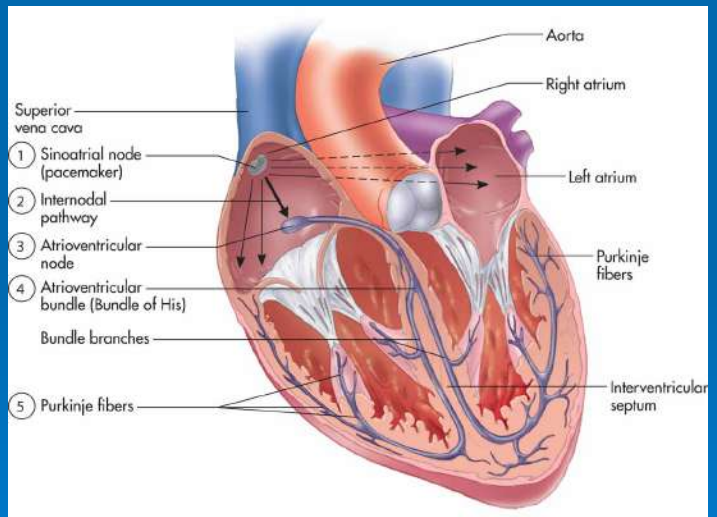
Sinoatrial (SA) node

- Located in wall of right atrium near entrance of superior vena cava.
- Generates electrical impulse at approximately 70–80 impulses per minute.



1. The sinoatrial (SA) node fires a stimulus across the walls of both left and right atria causing them to contract.
2. The stimulus arrives at the atrioventricular (AV) node.
3. The stimulus is directed to follow the AV bundle (Bundle of His).
4. The stimulus now travels through the apex of the heart through the bundle branches.
5. The Purkinje fibers distribute the stimulus across both ventricles causing ventricular contraction.

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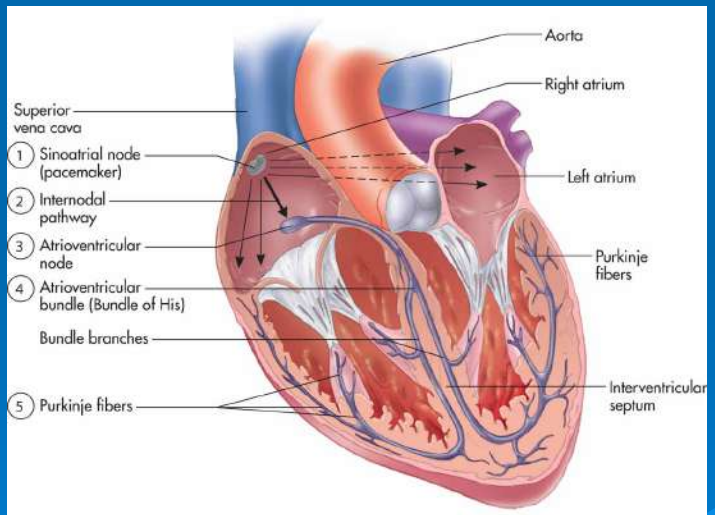
Atrioventricular (AV) node

- Located at point where atria & ventricles meet
- Generates electrical impulse at rate of 40–60 beats per minute.
- Acts as a "back-up" if SA node fails



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Factors that affect Heart Rate

- Emotion
- Fever
- Blood/water loss
- Ions, hormones
- Gender: Males = 64-72, Females = 72-80
- Hypokalemia: Low K+ = weak heartbeat
- Hypercalcimia: High calcium can prolong heart muscle contractions to point where heart can stop beating.

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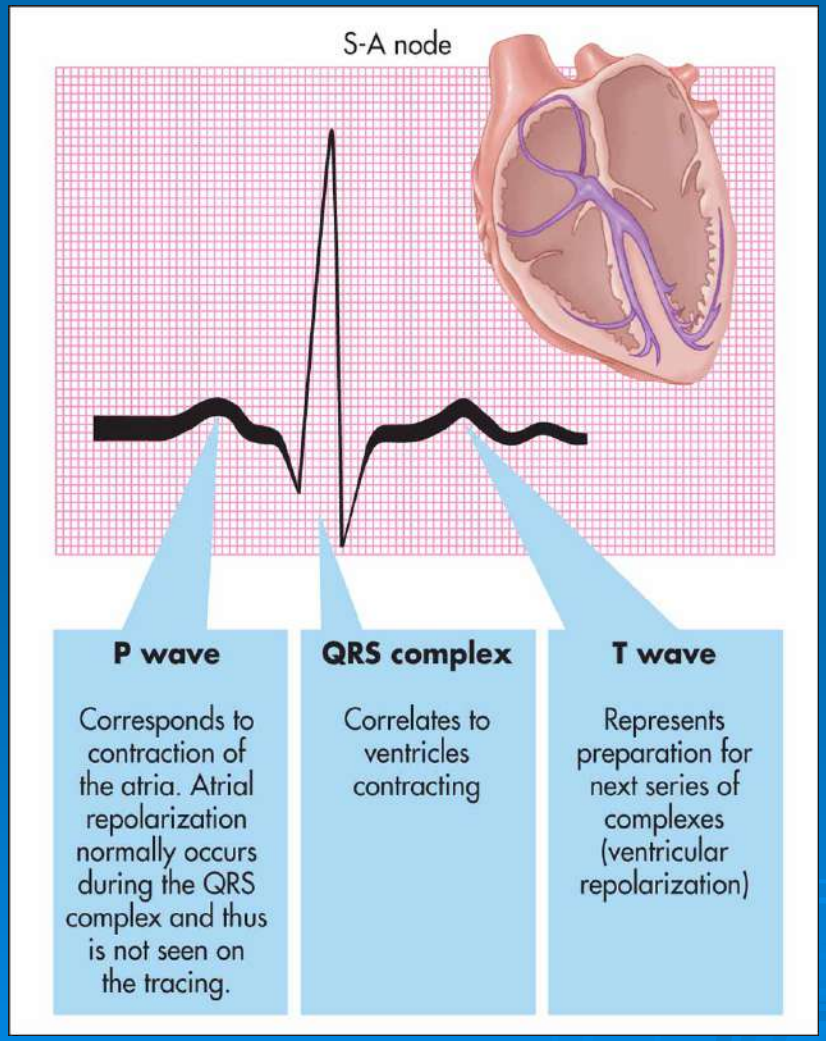
PQRST



- P Wave:
  Atrial Contraction
- QRS complex:
  Ventricular contractions.
- T Wave:
  Ventricular repolarization

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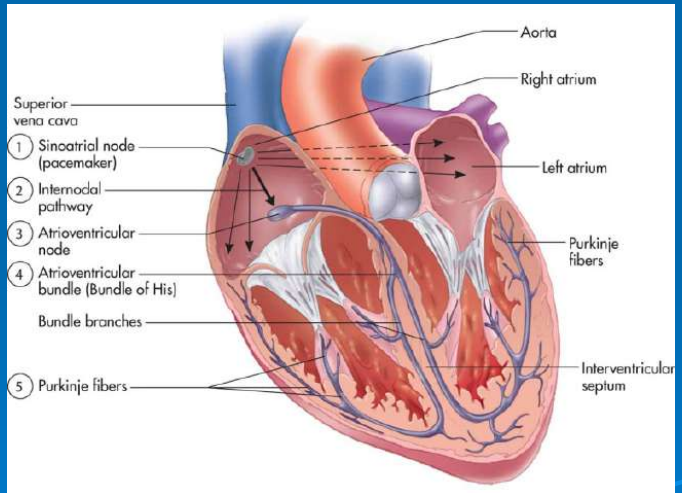
Pathology Connection

Arrhythmia (dysrhythmia):

- Abnormal heartbeat
- Due to electrical problem, electrolyte or fluid imbalance or trauma, drug overdose.



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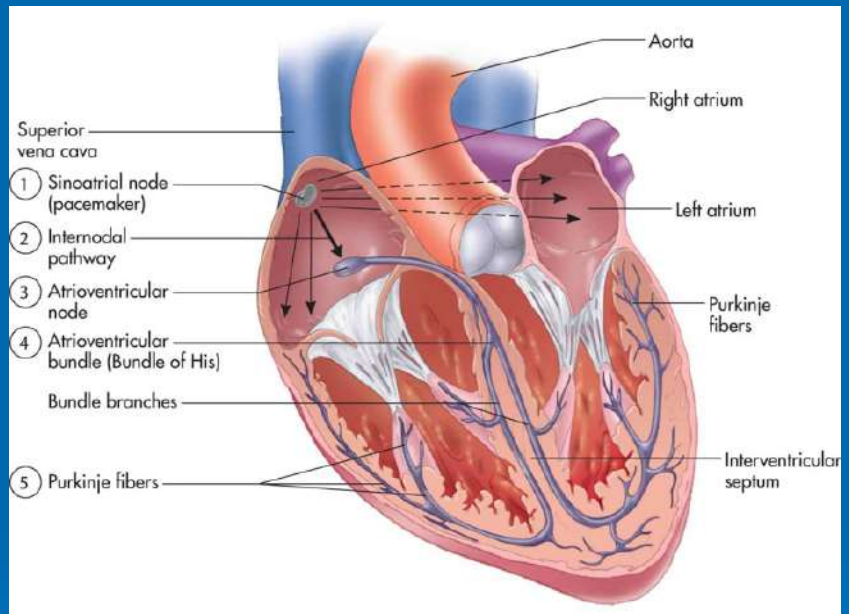
Electrical Pathway of the Heart



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5. The Purkinje fibers distribute the stimulus across both ventricles causing ventricular contraction.

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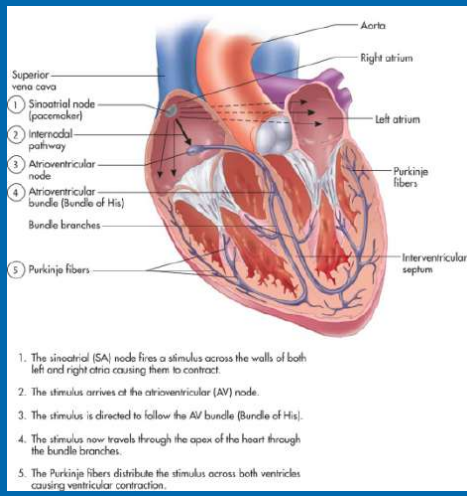
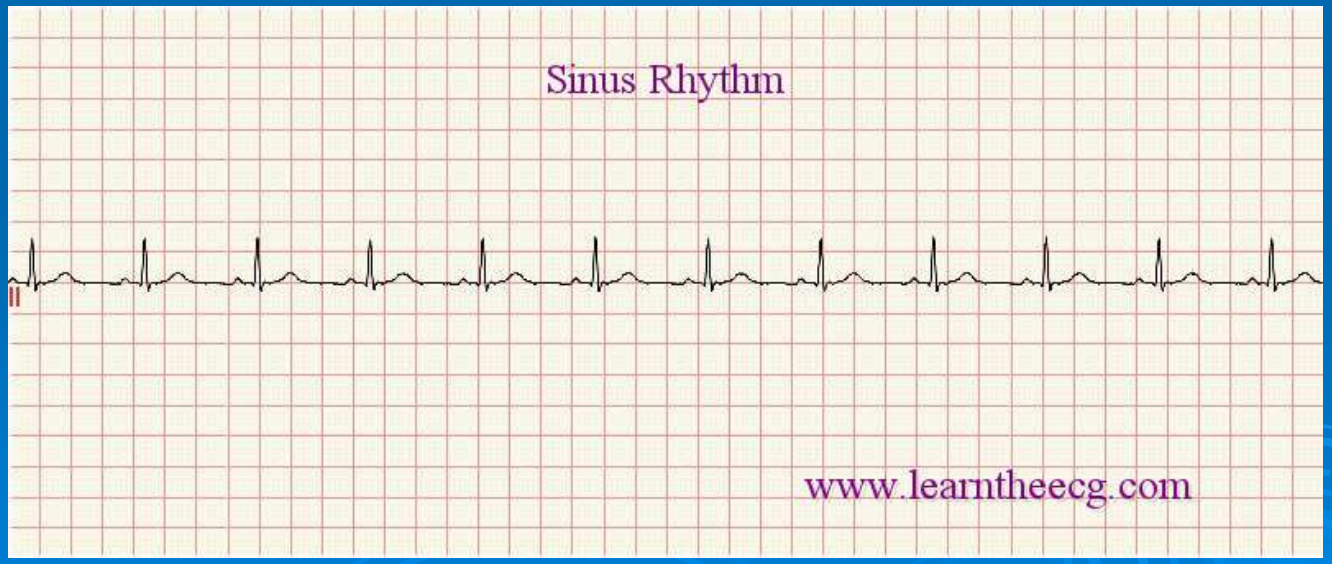
Normal Sinus Rhythm (NSR)

- P waves present, consistent & regular
- R waves regular
- Rate = 60-99 bpm





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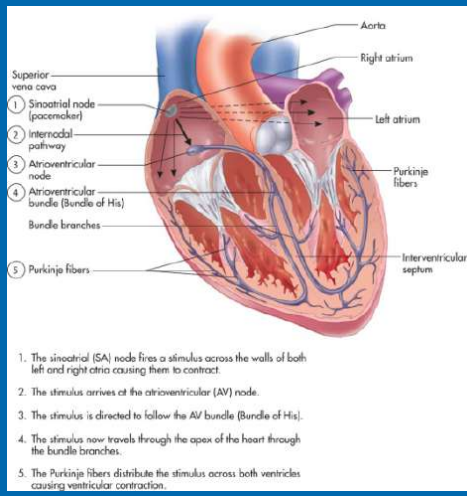
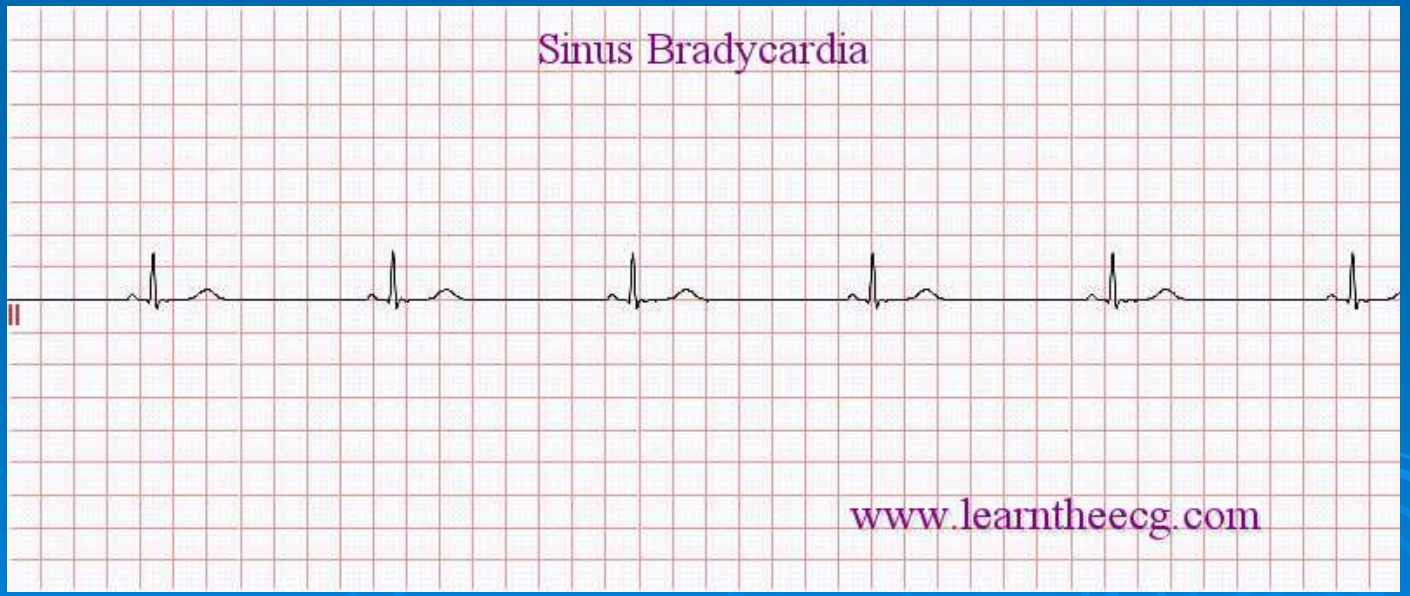
Sinus Bradycardia

- P waves present, consistent & regular
- R waves regular
- Rate = 40-60 bpm
- Can be normal if athletic





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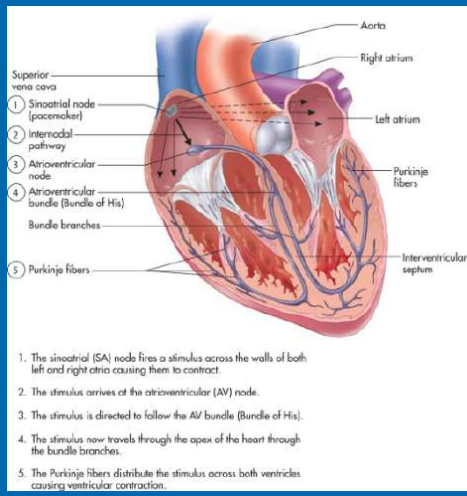
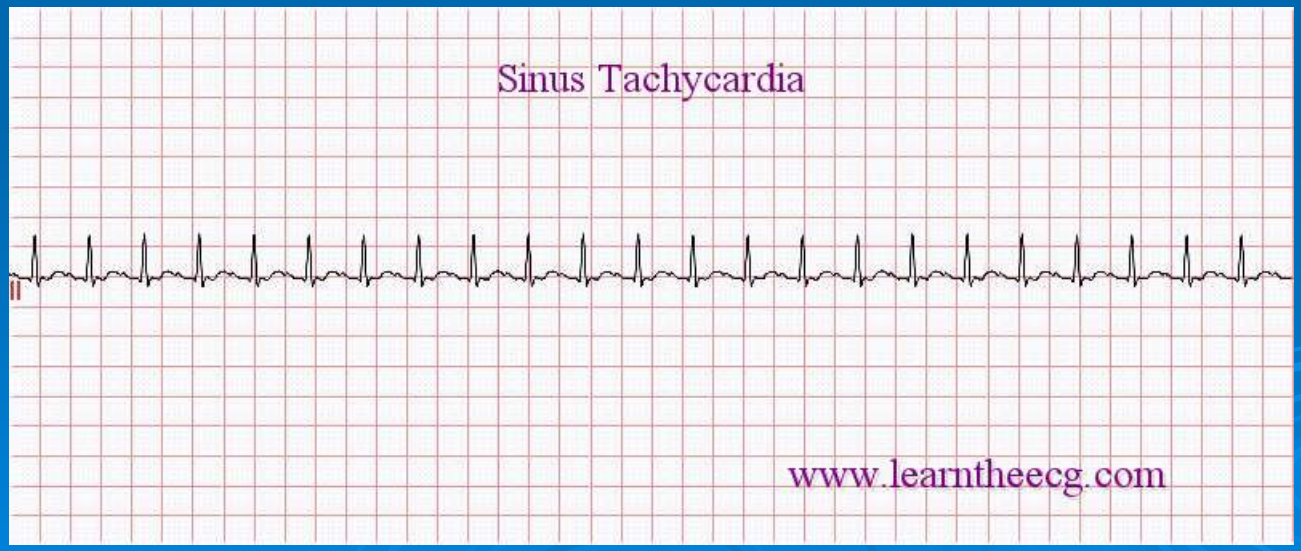
Sinus Tachycardia

- P waves present, consistent & regular
- R waves regular & fast
- Rate = 100-150 bpm



Etiology

- Normal: athletic activity
- Abnormal: Fever, hemorrhage, hypoxia, fear, drugs



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Premature Atrial Contractions (PACs)

- P waves present, consistent & regular
- R waves irregular and premature
- Rate = varies

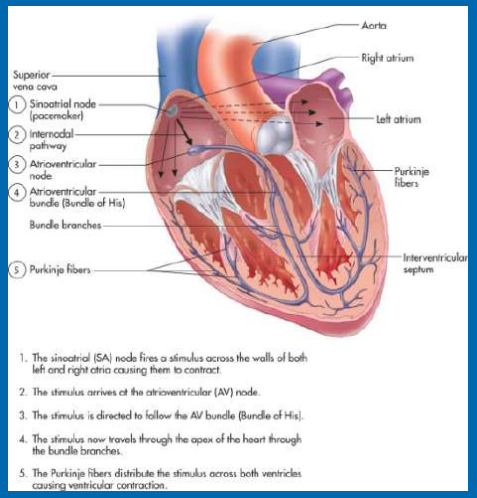
Etiology:

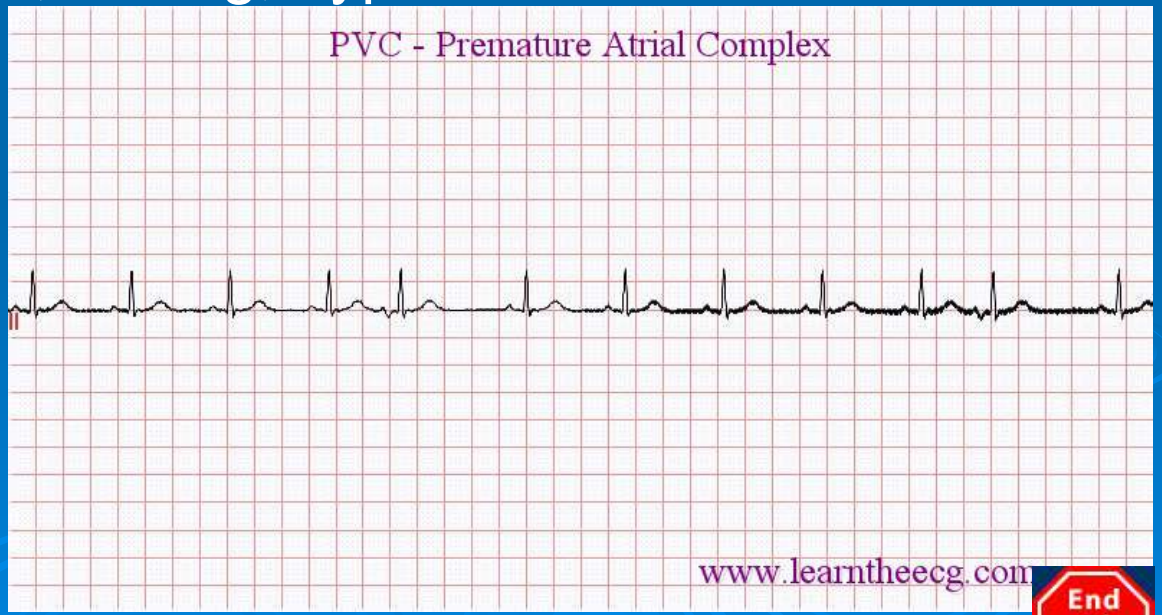
- Normal: usually, not life threatening
- Abnormal: stress, fear, dieting, hypoxia

RX:

- Remove emotional

or physical cause.





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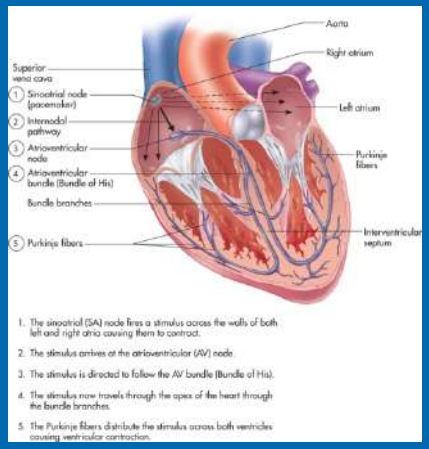
Junctional Rhythm (JR)



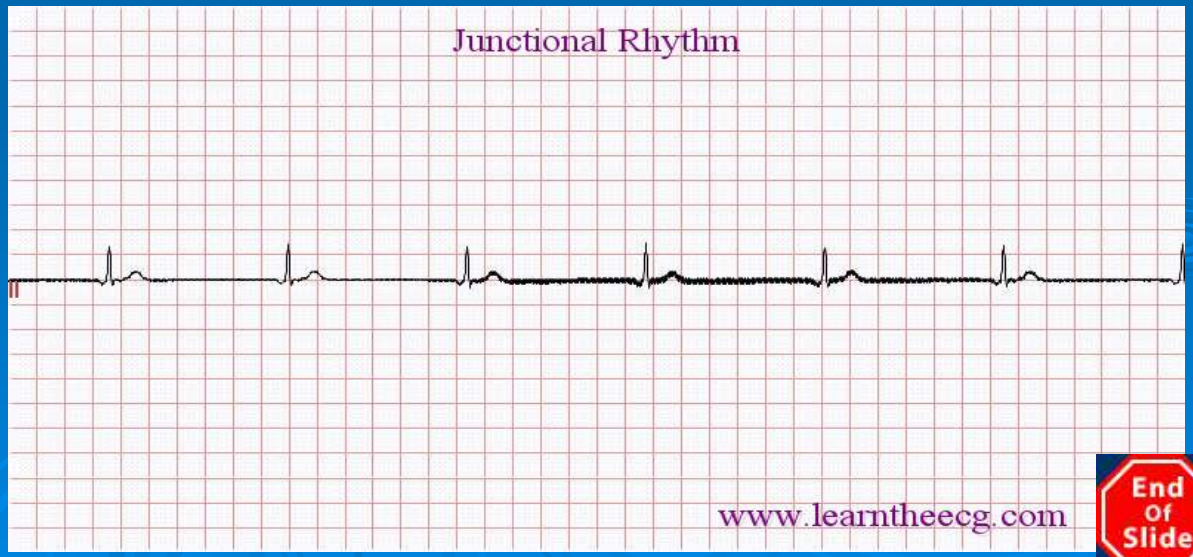
- P waves absent
- R waves regular
- Rate = 40 +

Etiology:

- Sinoatrial (SA) node failure, MI, CHF, hypoxia, drugs

RX:

- O2
- Atropine sulfate
- ExternalPacer
- Internal Pacer



Atrial Flutter

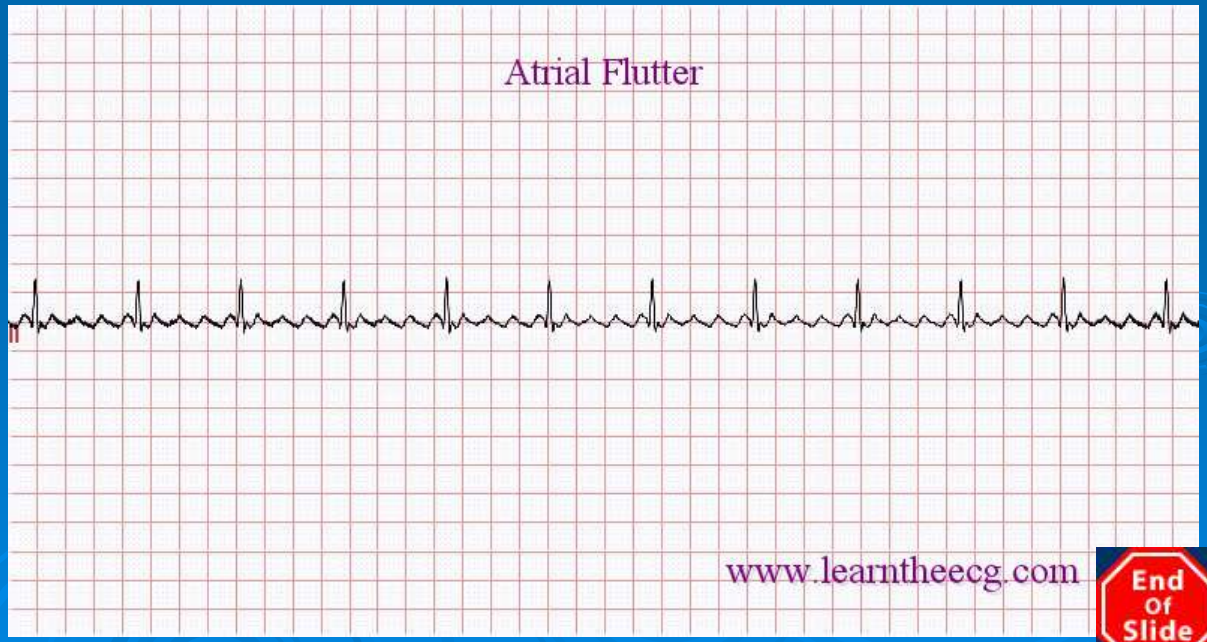
- P waves multiple & frequent @ rate of 230-380 bpm
- R waves regular & fast
- Ventricular rate = varies & usually fast

Etiology:

- Sinoatrial (SA) node failure, hypertension, coronary artery disease, and cardiomyopathy)

RX:

- Drugs
- Cardioversion
- Ablation



Atrial Fibrillation (A-Fib)

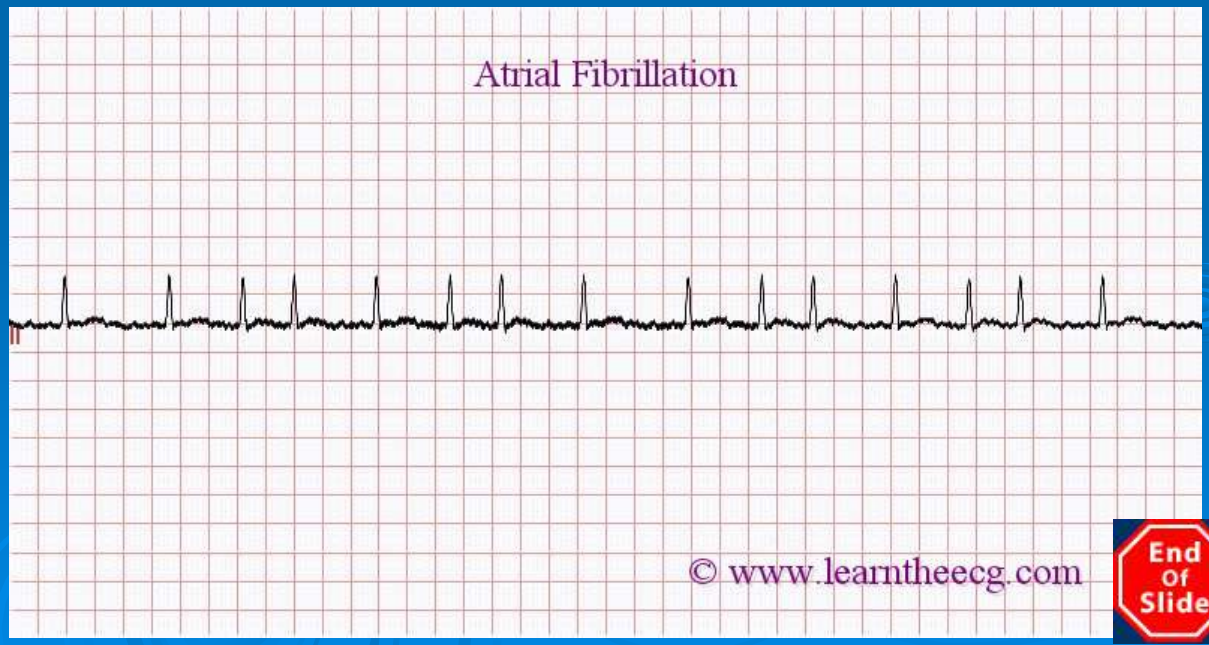
- P waves very rapid & uncoordinated
- R waves irregular & fast or slow
- Ventricular rate = varies usually 80-100 bpm

Etiology:

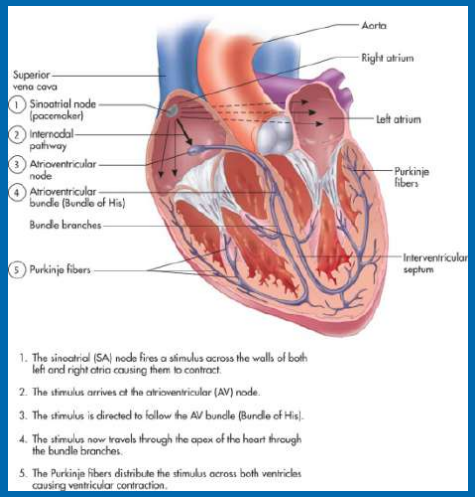
- Sinoatrial (SA) node failure, hypertension, coronary artery disease, and cardiomyopathy)

RX:

- Drugs
- Cardioversion
- Ablation



Unifocal Premature Ventricular Contractions (PVCs)



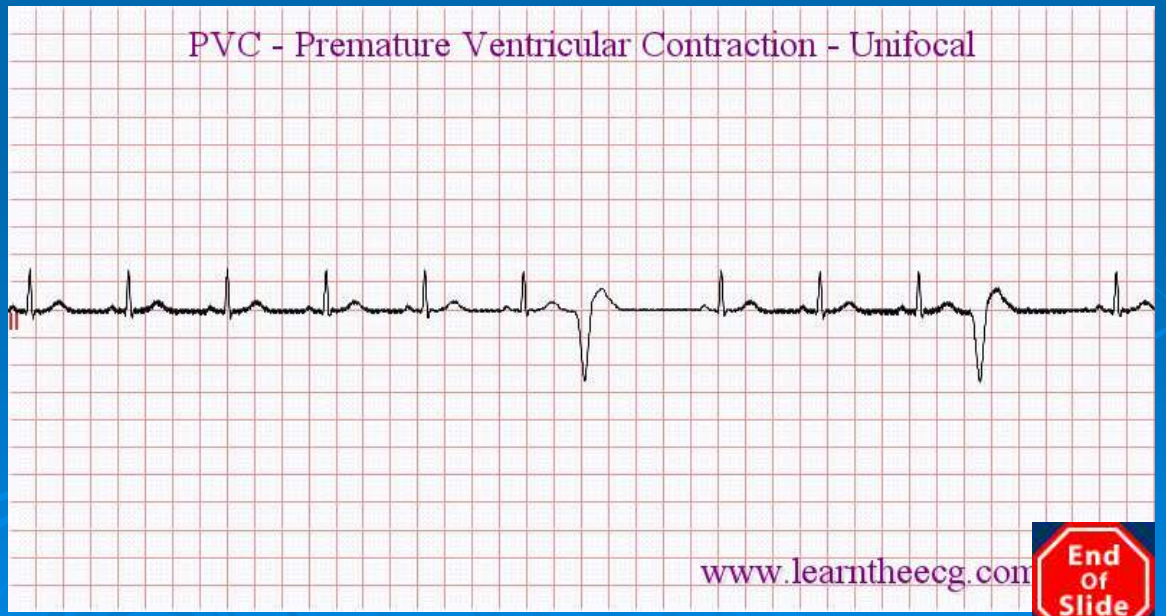
- P waves absent
- R waves irregular & wider than normal
- Ventricular rate = irregular

Etiology:

- Ischemia, MI, drugs, myocarditis, smoking, caffeine

RX:

- Remove cause
- Drugs
- Oxygen



Multifocal PVCs

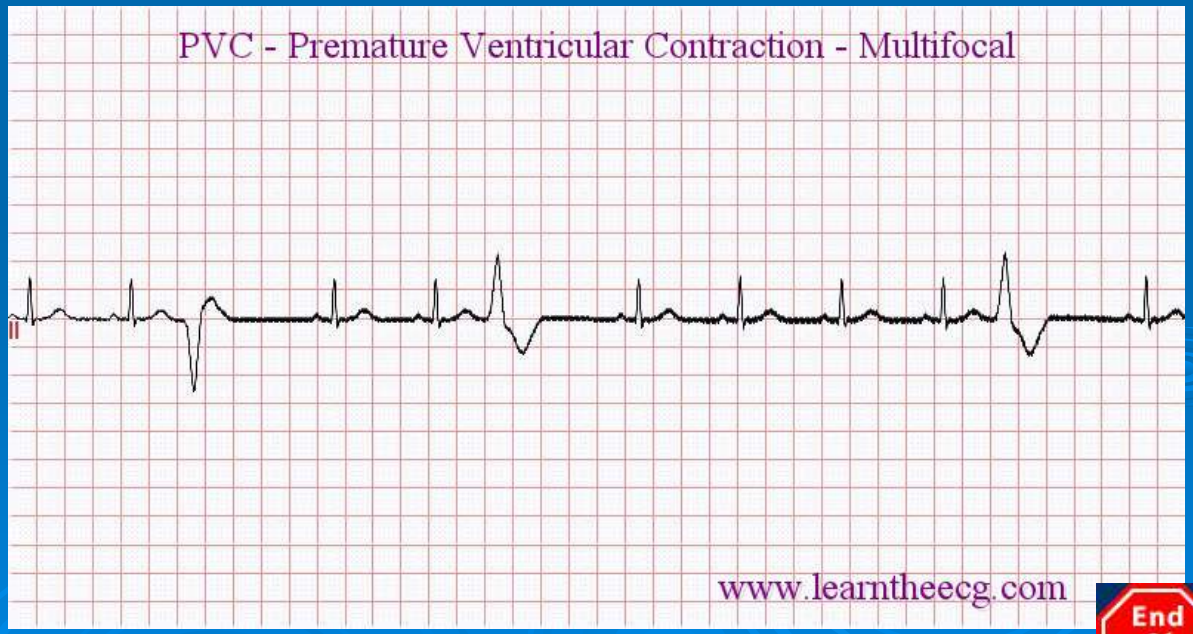
- P waves absent
- R waves both positive & negative deflections
- Ventricular rate = irregular

Etiology:

- Ischemia, MI, drugs, myocarditis, smoking, caffeine

RX:

- Remove cause
- Drugs
- Oxygen



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Ventricular Tachycardia (VT)

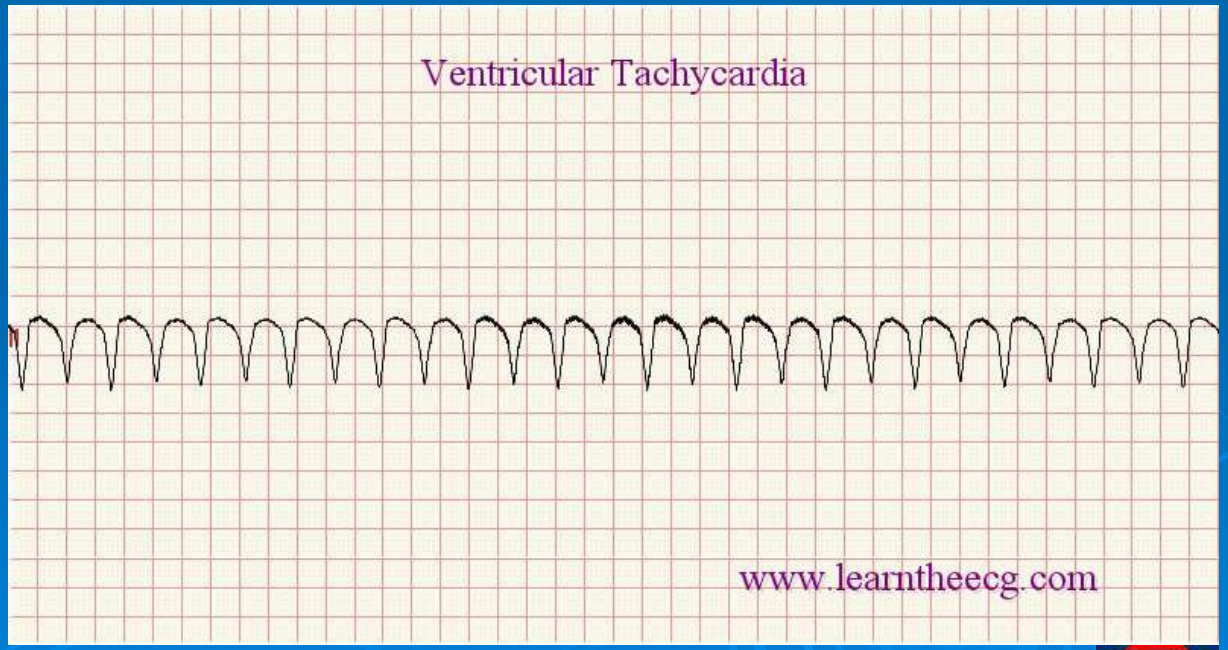
- P waves absent
- R waves irregular & wider than normal
- Ventricular rate = irregular
- Life threatening emergency

Etiology:

- a tachycardia that originates in one of the ventricles of the heart

RX:

- Remove cause
- Oxygen
- Drugs
- Electrical or chemical cardioversion
- CPR if LOC or no pulse! ! !



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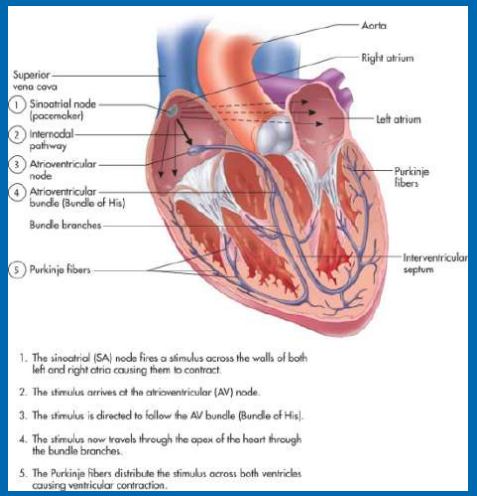
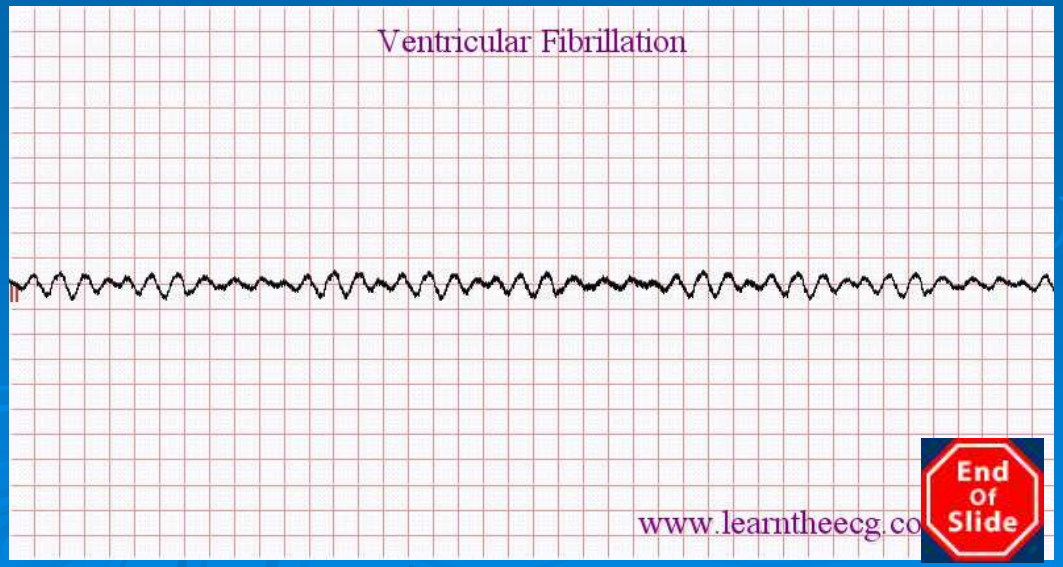
Ventrical Fibrillation (V-Fib)

- P waves absent
- R waves absent
- Ventricular rate absent
- Life threatening emergency
- No pulse



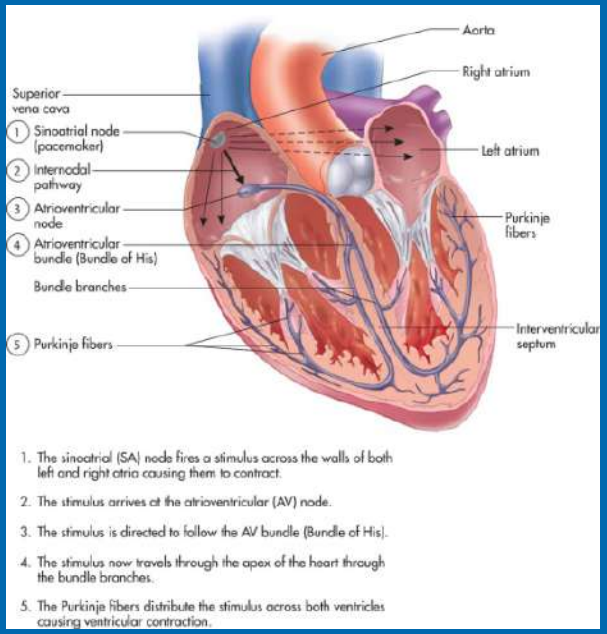
Etiology:

- No coordinated atrial or ventrical contractions
- RX:
- Defibrillation
- CPR
- Drugs
- Oxygen



PEA: Pulse-less Electrical Activity

- P waves present, regular or irregular
- R waves regular or irregular
- Rate = varies fast or slow



Etiology:

- there is electrical activity, but the heart does not contract.
- results in an insufficient cardiac output to generate a pulse and supply blood to the organs.

Rx:

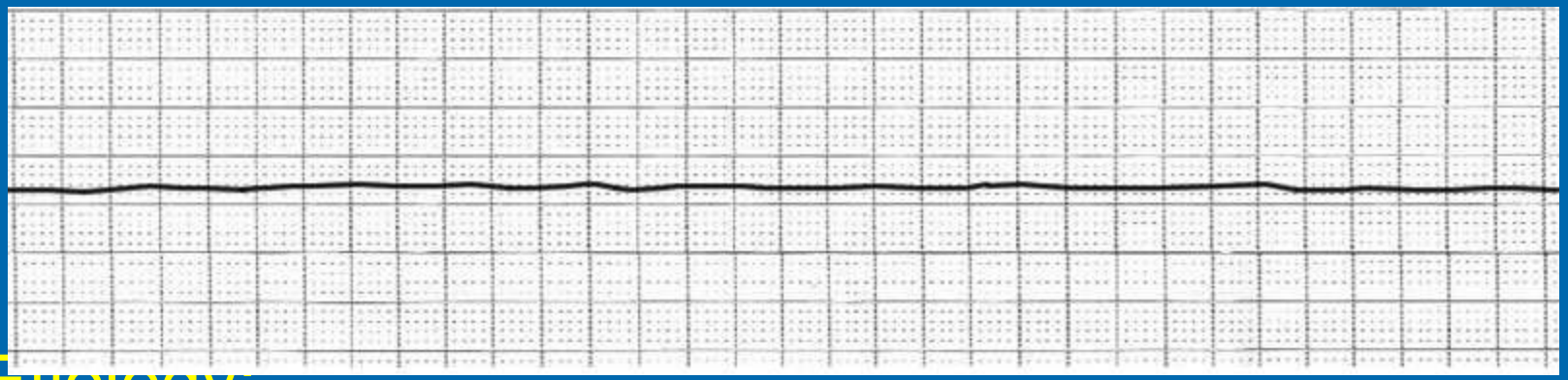
CPR with Intubation

Epinephrine, Atropine, Vasopressin

External Pacer

End Of Slide

Asystole



Etiology:

No cardiac electrical activity at all

No cardiac perfusion at all

Rx:

CPR

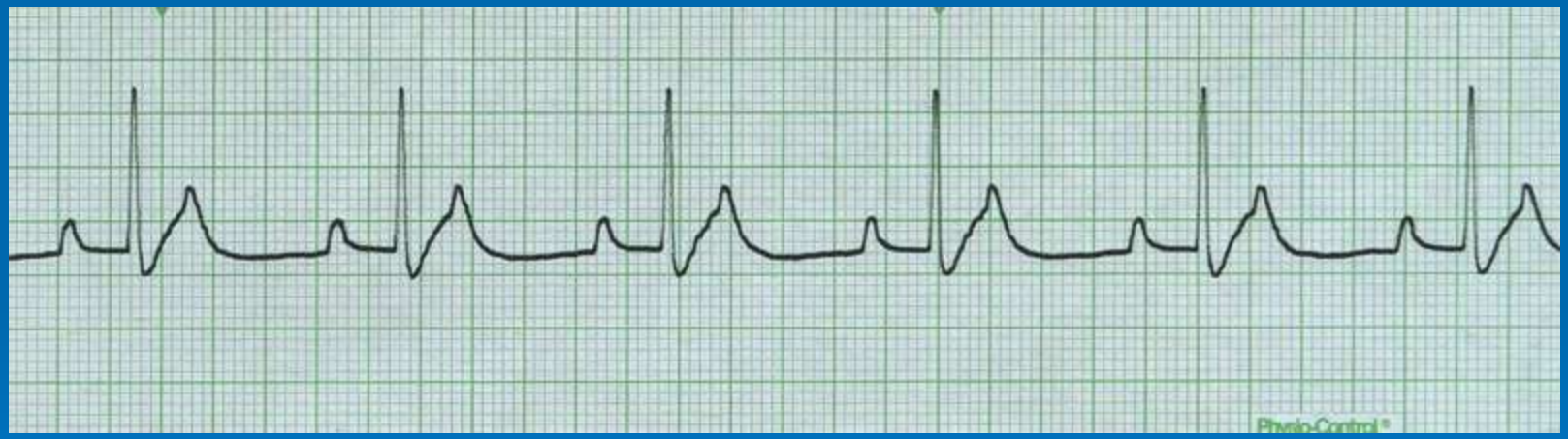
Intubation O2

Drugs: Epinephrine, Atropine, Vasopressin

prayer

End Of Slide

1st Degree AV Block



1st Degree AV Block

P waves: present, but prolonged PR interval >.20 seconds
R waves: present and regular
There is a delay between atrial depolarization and ventricular depolarization.
Etiology: enhanced vagal tone (for example in athletes),myocarditis, MI, electrolyte disturbances and medications
RX: treat cause, not a life-threatening dysrhythmia

2nd Degree AV Block: Type 1

2nd Degree AV Block: Type 1

P waves: “march out”; PR interval gradually lengthen in successive cycles and the last P wave fails to conduct to the ventricles
R waves: irregular because there is a dropped QRS complex
Also known as Wenckebach

2nd Degree AV Block: Type 1

Etiology: parasympathetic excess (inhibits AV node), MI, myocarditis, and drugs

RX: IV Atropine or Isoproterenol if symptomatic, tx cause

2nd Degree AV Block Type 2

Known as Mobitz 2

P waves: intermittently nonconductive, no PR interval prolongation, can progress to complete heart block, can be 2:1 block, 3:1 block, or more (ratio: P waves to QRS)

R waves: less present than P waves, only present when there is conduction through AV node

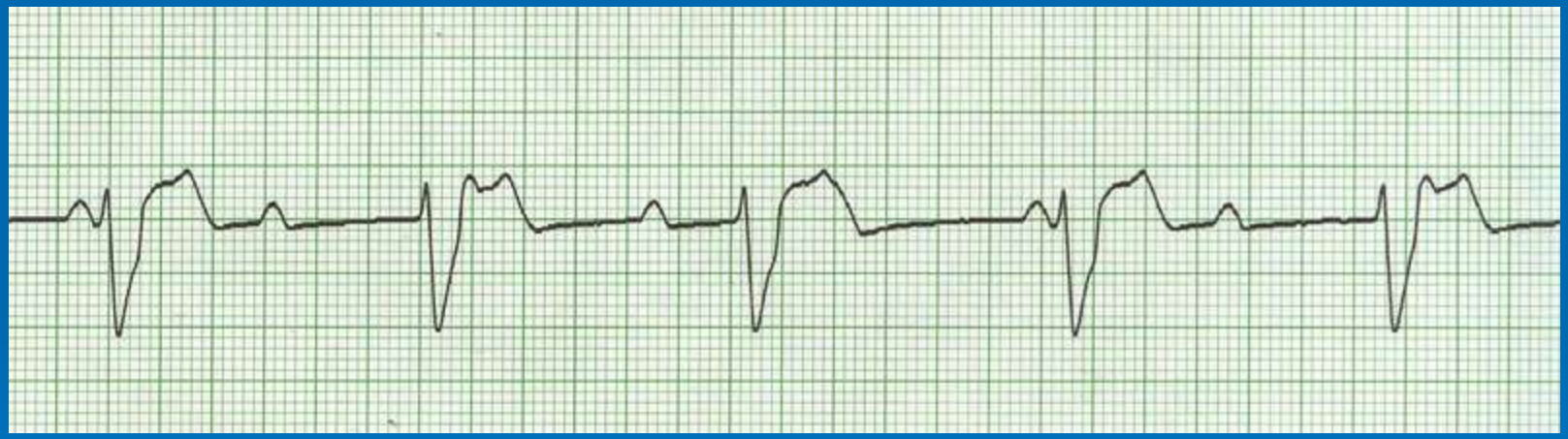
2nd Degree AV Block:Type 2

Etiology: MI, cardiomyopathy

RX: trancutaneous pacing, possible implantable pacemaker

http://lifeinthefastlane.com/wp-content/uploads/2011/04/Mobitz_II.gif

3rd Degree Heart Block



3rd Degree AV Block

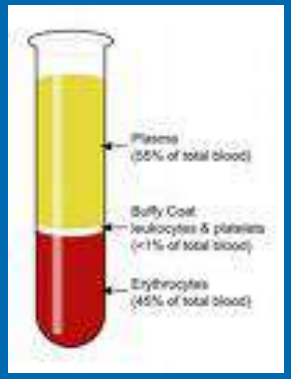
Complete heart block
No electrical impulses reach ventricles, ventricles will occasionally fire on their own
P waves: present, but not in sync with QRS
R waves: present, but not in sync with P waves, “ventricular escape beats”

3rd Degree Heart Block

Etiology: MI, cardiomyopathy, drugs, valve abnormalities

RX: definite internal pacemaker

Blood



- Fluid form of connective tissue
- Usually 4 to 6 liters of blood or 9 to 13 units
- 7 to 9% of your total body weight
- Men have more than women

3 Functions

- Transportation
- Regulation
- Protection

End Of Slide

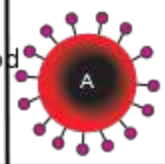
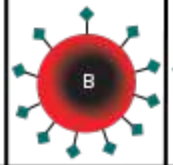
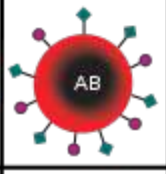
Blood Typing

Antigens

- Substance that stimulates immune system to produce antibodies.

Agglutination

- When antigens stick together in little clumps

	Group A	Group B	Group AB	Group O
Red blood cell type				
Antibodies present	 Anti-B	 Anti-A	None	 Anti-A and Anti-B
Antigens present	A antigen	B antigen	 A and B antigens	None

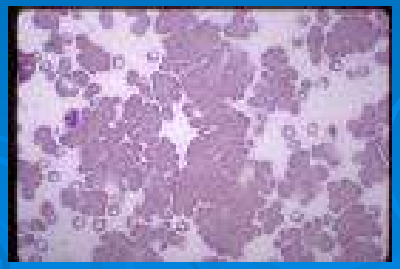
End Of Slide

Type A

- Very common; about 41% of American population
- Type Anti-B antibodies present to fight the blood

Type B

- Plasma contains anti-A antibodies
- If person with type B blood was given type A blood, anti-A antibodies would attack donated red blood cells and destroy them.
- Antibodies cause agglutination, resulting in serious harm & even death.



agglutination

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Type AB

- Contain both A and B self antigens
- Neither A or B antibodies in plasma
- Type AB blood are called universal recipients because they can accept any type of blood type transfusion

Type O

- RBCs contain no A or B antigens, but its plasma contains both A & B antibodies.
- can be given to anyone
- universal donor