

Chapter 15



Cardiovascular System

FYI

- The heart pumps 7,000 liters of blood through the body each day
- The heart contracts 2.5 billion times in an avg. lifetime
- The heart & all blood vessels make up the cardiovascular system

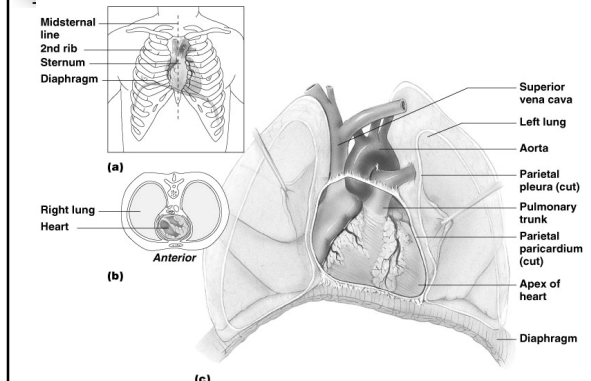
The Cardiovascular System

- **Cardiology**
- **Closed system** of the heart & blood vessels
 - Heart pumps blood
 - Blood vessels circulate blood to all parts of the body
- **Functions**
 - delivers O₂ & nutrients
 - removes CO₂ & other waste products

Heart Location

- Medial to lungs
- Posterior to sternum
- Anterior to vertebral column
- Between 2nd –6th ribs
- Lies on diaphragm
- About the size of your fist; ~ 1 pound
 - Right & left atriums
 - Right & left ventricles

The Heart

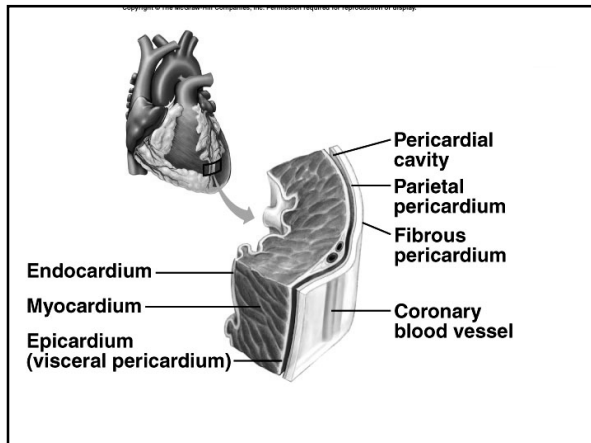


Heart Coverings

- Pericardium – membranes surrounding heart
- 2 layers - serous pericardium & fibrous pericardium
- Serous pericardium – double membrane
 - Visceral pericardium – (also called epicardium) – layer covering heart
 - Parietal pericardium – lines fibrous pericardium

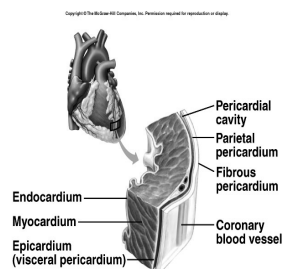
The Heart: Coverings

- Fibrous pericardium – outermost CT surrounding heart
- Pericardial cavity – space between parietal & visceral layers
- Serous fluid fills the space between the layers of pericardium; acts as lubricate
- Pericarditis – inflammation of pericardium or serous fluid



Heart Wall

- 3 layers
 - Epicardium
 - Outermost layer of heart
 - Visceral pericardium
 - Myocardium
 - Middle layer
 - Cardiac muscle
 - Endocardium
 - Inner lining of chambers & valves



Heart Chambers

- Right & left side act as separate pumps
- 4 chambers
 - Atria - upper receiving chambers
 - Right & Left atrium have thin walls
 - Interatrial septum – wall separating atria
 - Auricles – flaps on top; allow expansion
 - Ventricles – lower discharging chambers
 - Right & Left ventricle - thick muscular wall for pumping
 - Interventricular septum – wall separating ventricles
 - Trabeculae carneae – inner folds & ridges

Heart vessels

- Veins –
 - Carry deoxygenated blood to the heart
 - Superior vena cava – carries blood from head & upper areas
 - Inferior vena cava – carries blood from lower limbs
 - Coronary sinus – carries blood from myocardium
 - Pulmonary veins – carries blood from lungs *
- Arteries –
 - Carry oxygenated blood away from the heart
 - Pulmonary arteries – carries blood to lungs*
 - Coronary arteries – carries blood to myocardium

Chambers & Vessels

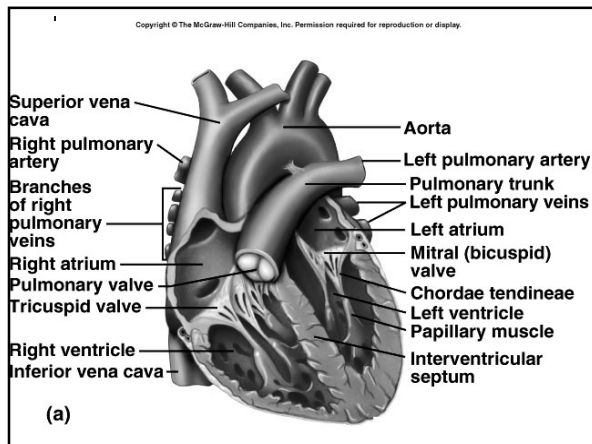
- Right atrium
 - Receives blood from
 - inferior vena cava
 - superior vena cava
 - coronary sinus
- Left atrium
 - Receives blood from
 - pulmonary veins
- Right ventricle
 - Receives blood from
 - right atrium
- Left ventricle
 - Receives blood from
 - left atrium

Heart Valves

- opening between chambers is called atrioventricular orifice;
- 4 valves
 - Atrioventricular valves – between atria & ventricles
 - Tricuspid valve (right AV valve) is located between R. atrium & R. ventricle
 - Bicuspid valve (mitral valve or left AV) valve is located between L. atrium & L. ventricle
 - Semilunar valves between ventricle & artery
 - Aortic semilunar valve – w/in aorta
 - Pulmonary semilunar valve – w/in pulmonary trunk

Heart Valves

- Valves open as blood is pumped through & close to prevent backflow
- Controls flow of blood in 1 direction
- Held in place by **chordae tendineae** (“heart strings”) attached to muscle wall
- **Papillary muscles** located on surface of ventricles control opening & closing of valves



Pathways within the Heart

- O₂ poor blood enters ♥ from 3 veins
 - **Superior vena cava** – returns blood from regions superior to the heart
 - **Inferior vena cava** – returns blood from regions below the heart
 - **Coronary sinus** – collects blood from myocardium
- **Right atrium** – 1st chamber of ♥; receives deoxygenated blood

Pathways within the Heart

- **Tricuspid valve** or right atrioventricular valve (right AV valve) – 3 valves or cusps that prevent backflow of blood from right ventricle to right atrium
- **Right ventricle**
- **Pulmonary semilunar valve** – valve between right ventricle & pulmonary trunk
- **Right & Left Pulmonary arteries** – carry blood to lungs; only artery that carries deoxygenated blood

Pathways within the Heart

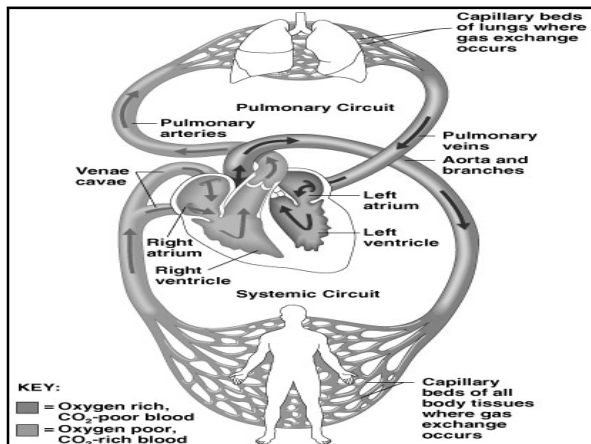
- **Alveolar capillaries** – site of gas exchange in lungs
- **Right & Left pulmonary veins (4)** – deliver oxygenated blood to the left atrium; only vein that carries oxygenated blood
- **Left atrium** – receives oxygenated blood from lungs

Pathways within the Heart

- **Bicuspid valve (mitral) or (left AV valve)**
 - prevents backflow of blood into the left atrium
- **Left ventricle**
- **Aortic semilunar valve** – valve between the left ventricle and the aorta
- **Aorta** – largest artery
 - Carries oxygenated blood away from the heart; systemic circuit

Blood circulation

- **Pulmonary circuit** –
 - collects deoxygenated blood returning to heart
 - Right side of heart
 - Responsible for gas exchange
- **Systemic Circuit**
 - Supplies body with oxygenated blood
 - Left side of heart



Coronary Circulation

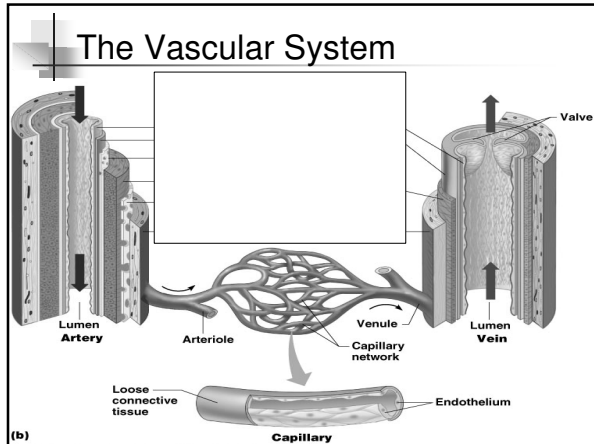
- The heart has its own circulatory system
 - Coronary arteries branch off base of aorta & supply heart w/oxygenated blood
 - Deoxygenated blood empties into the right atrium via the coronary sinus

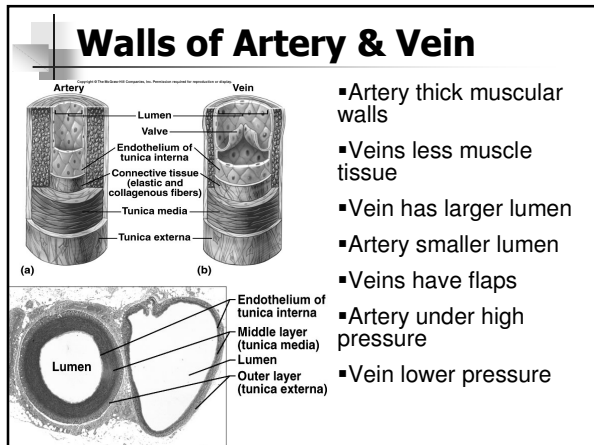


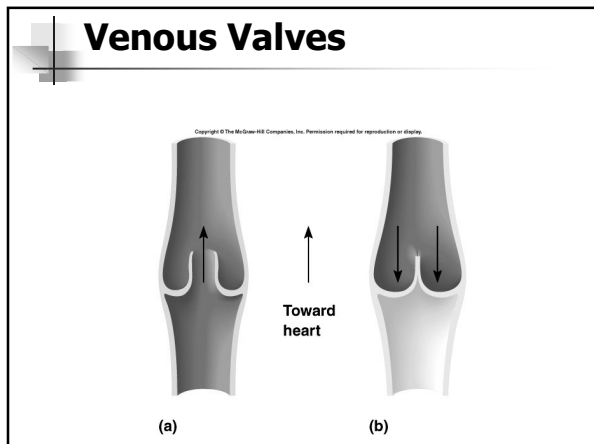
**Angiogram of
Coronary
Arteries**

Blood Vessels

- Taking blood to the tissues & back
 - Arteries – carry oxygenated blood away from heart
 - Arterioles – smaller division of arteries
 - Capillaries – smallest vessels; 1 cell layer
 - Site of gas exchange- O_2 released & CO_2 absorbed
 - Venules – receive deoxygenated blood & waste; smaller division of veins
 - Veins – carry deoxygenated blood back to heart

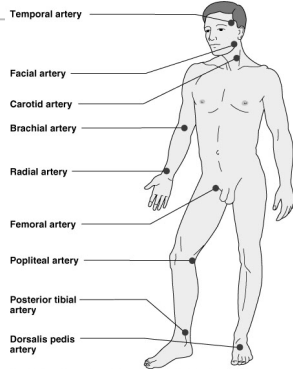






Pulse

- Pulse – pressure wave of blood
- Monitored at “pressure points” where pulse is easily palpated
- Strongest closer to the heart
- Normal rate 70-80 bpm
- Tachycardia > 100 bpm
- Bradycardia <60 bpm



Blood Pressure

- The force the heart creates as it pushes blood through the arteries
- Sphygmomanometer – instrument used to measure blood pressure
- Measurements are made on large arteries
 - Systolic – pressure at ventricular contraction; highest #
 - Diastolic – pressure when ventricles relax; lowest #
- Pressure in blood vessels decreases as the distance away from the heart increases
- Dilating/constricting arterioles helps regulate blood pressure

Variations in Blood Pressure

- Normal
 - ~120 mm Hg systolic (top #)
 - ~80 mm Hg diastolic (bottom #)
 - Fluctuates throughout the day
- Hypotension
 - Low systolic (below 90 mm HG)
- Hypertension
 - High systolic (above 140 mm HG)
 - Can be dangerous if it is chronic

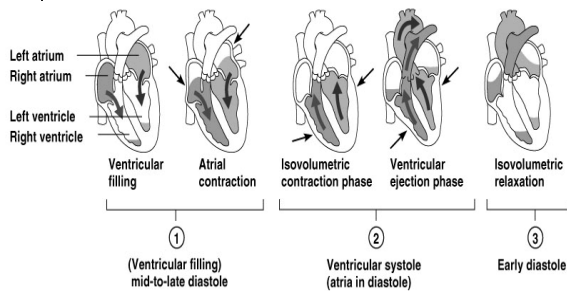
Factors that Influence Blood Pressure

- Diet – lower intake of high salty foods; caffeine, fatty foods
- Blood volume – dehydration; loss of blood
- Temperature – heat causes vessels to dilate; cold causes vessels to constrict
- Chemicals – many drugs can cause increase of decrease of BP (cough or cold meds)

Cardiac Cycle

- The myocardial contractions (systolic & diastolic) that makes up a complete heart beat.
- Systole – contraction
- Diastole - relaxation
- When atria are in systole, ventricles are in diastole
- When atria are in diastole, ventricles are in systole
- Atria contraction forces blood into ventricles
- As ventricles begin to contract, AV valves close
- ↑ pressure forces semilunar valves to open & pushes blood throughout body
- During ventricle contraction, atria relax & blood flows in

Cardiac Cycle



Heart Sounds

- 1st sound – “lub” -
 - AV valves close (tricuspid & bicuspid)
 - Ventricular contraction
- 2nd sound – “dub” –
 - Semilunar valves close (aortic & pulmonary)
 - Ventricular relaxation
- Murmur – abnormal heart sound usually caused by irregularities in valves

Heart Conduction System

- Cardiac cells that initiate impulses thru heart; causes heart muscles to contract & relax

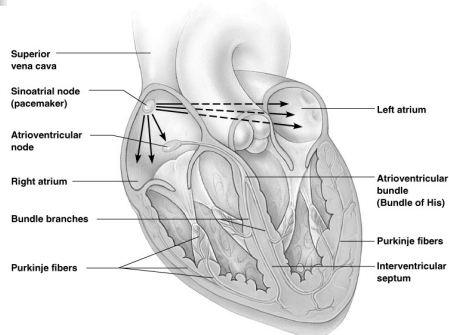
Parts of Conduction System

- Sinoatrial node – known as SA node or Pacemaker
 - Sets heart rhythm
 - Located R. upper atrial wall near S. vena cava
 - Produces electrical impulse that causes atria to contract; wave spreads to ...
- Atrioventricular node – AV node
 - Located in interatrial septum
 - Slight delay allowing atria to complete contraction; then wave moves to...

Parts of Conduction System

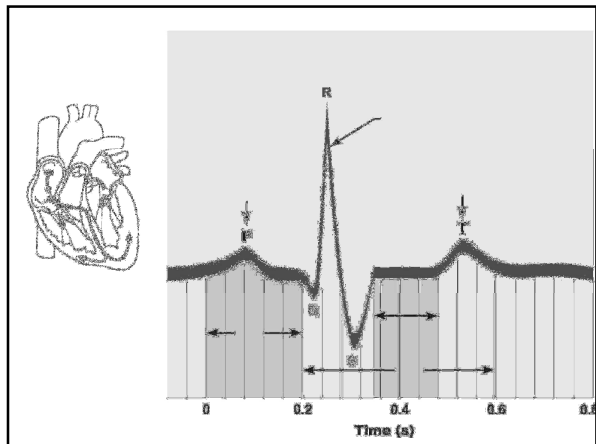
- Atrioventricular bundle – AV bundle
 - Located in interventricular septum
 - Passes wave impulse to Right & Left ...
- Bundle branches –
 - Located in interventricular septum
 - Pass wave impulses to Right & Left ...
- Purkinje fibers
 - Located in the ventricular myocardium
 - Triggers ventricular contraction
 - Ventricle contraction begins at apex & pushes blood through arteries

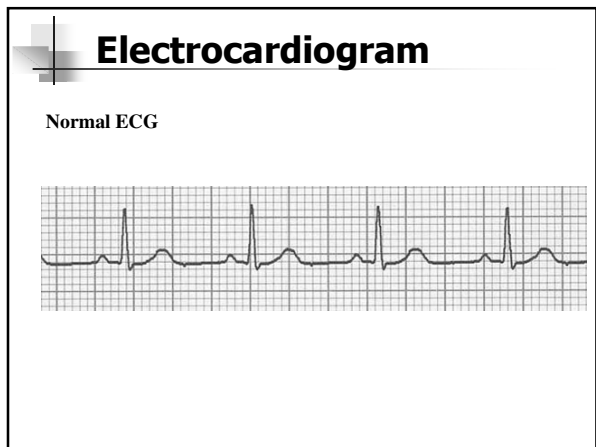
Heart Contractions

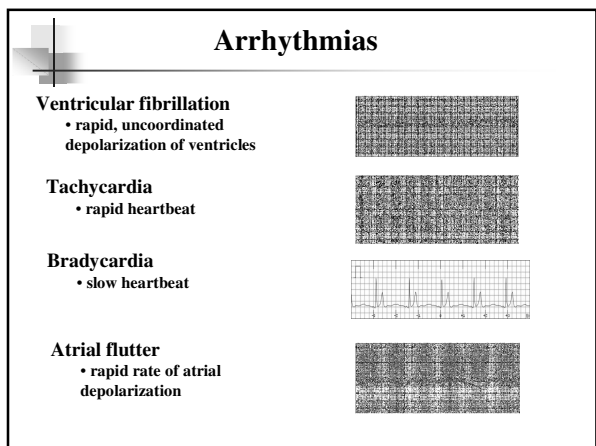


Technology

- Electrocardiogram – (ECG) graph showing electrical activity of heart
- 3 parts of ECG
 - P wave – smallest wave; atrial contraction (depolarization)
 - QRS complex – largest wave; ventricle contraction
 - T- wave – relaxation (repolarization) of ventricle







Defects

- Ischemia – reduced blood flow
- Hypoxia – reduced O₂ due to ischemia
- Angina – chest pain caused by myocardial ischemia
- Myocardial infarction – heart attack
 - Caused by thrombus or embolus in coronary arteries
 - May cause death to myocardial tissues
- Arrhythmia – irregular heart rhythm

Defects

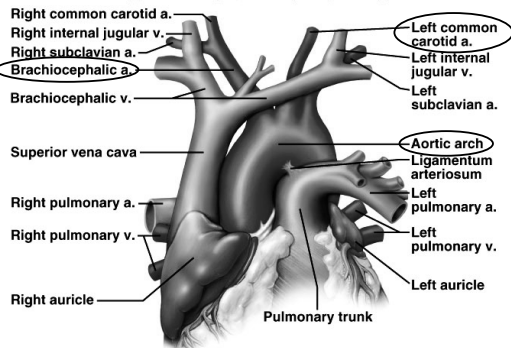
- Fibrillation – irregular contractions
 - Defibrillator – shocks heart to interrupt irregular contractions; hopefully SA node fires & sinus rhythm is reestablished
- Mitral prolapse – mitral valve bulges into atrium space
- Tachycardia – fast heart rate
- Bradycardia – slow heart rate
- Aneurysm – abnormal expansion of an artery
- Phlebitis – inflammation of a vein
- Arteriosclerosis – hardening of the arteries

Vessels of Arterial System

- Ascending aorta – 1st part leaving heart
- Aortic arch – curved area w/other arteries
- Brachiocephalic artery – carries blood to R. arm & R. side of head
- Subclavian artery – carries blood to left arm
- Carotid artery – carries blood to L. side of head
- Descending or thoracic aorta – carries blood to lower extremities
- Abdominal aorta – carries blood to abdominal area & then branches into each leg

Major Arteries Of Heart

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Major Veins Of Heart

- Superior vena cava – from upper regions of body
- Inferior vena cava – from lower regions of body
- Jugular – from head to heart
- Brachiocephalic – 2 veins from left & right arms
- Coronary sinus – from myocardium
