

VIII. Circulatory System

A . Definition- all structures involved in the circulation of permanent body fluids

1. *Cardiovascular system*

- heart, Blood vessels, Blood

2. *Lymphatic system*

Lymph vessels, nodes, and lymph

B. Major Structures

1. *Heart*

a. Double pump

b. Size and shape of fist

c. Loc. Directly behind sternum, loud on left

2. *Blood Vessels*

a. Arteries - carry blood away from heart

See Diagram for names

b. Vein - Carry blood toward heart

See diagram for names

C. Anatomy of the Circulatory System

1. Vessels

a. *Arteries*

1) s. squam, thick muscle, connective

2) high BP & velocity

b. *Arteriole - small artery*

1) S.S., medium muscle, conn.

2) Medium BP & velocity

c. *Capillaries*

1) Only Sim. Squam.

2) Exchange of material

d. *Venules - small vein*

1) S.S., very thin musc, conn.

e. *Veins*

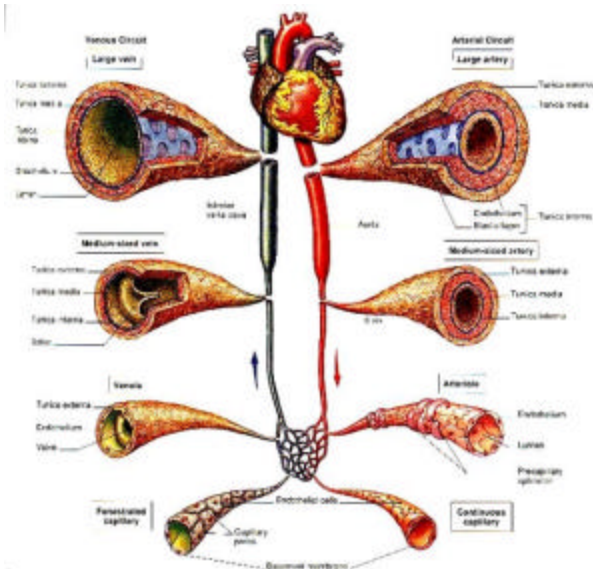
1) S.S., Medium musc., conn

2) Semilunar valves - uphill flow

f. *Anastomoses*

1) Not a Vessel

2) Alternate route for bloodflow to a specific location (not heart or brain)



2. Heart

a. General Info

- 1) Loc. In thoracic cavity
- 2) Shape - a blunt cone, not a
- 3) Made of card. Musc. between layers of conn. tissue

b. Chambers

Atria

Ventricles

c. Walls of Heart

- 1) 3 layers

a) *Endocardium* - inner watertight liner

b) *Myocardium* - heart muscle

c) *Epicardium* - outer layer

d. Pericardium - protection (like meninges)

- 1) *Fibrous pericardium* - White fibrous - protects from contact with sternum / vertebrae

- 2) *Serous pericardium* - waterproof liners

parietal peri. - Stuck to inner surface of FC

pericardial fluid - isotonic (saline) fluid, cushioning

Visceral peri. - Same structure also called the *epicardium*.

e. Valves

- 1) Atrioventricular

a) *Rt. A-V (tricuspid)* - between rt. Atria and rt. ventricle

b) *L A-V (mitral)* - between left atria and left ventricle

- 2) Semilunar

a) *Aortic S-L* - between left ventricle and aorta

b) *Pulmonary S-L* - between rt ventricle and pulmonary artery

3. Physiology of Circulation

a. Why does blood flow?

- 1) Pressure differences (Blood moves High to Low)
- 2) Mostly the work of the heart

b. Work of the heart

1 Cardiac Muscle Tissue

Anatomy

- 1) Branched - 3-D contraction
- 2) Multinucleated, many mitochondria

Physiology

- 1) Involuntary
- 2) Spontaneous - beat on own
- 3) Synchronized - beat in unison
- 4) Don't fatigue - great blood supply, many mito

Systole' - time when heart is contracting

d)Diastole' - time when heart is relaxing

Pathway of bloodflow through heart (see your labeled diagram)

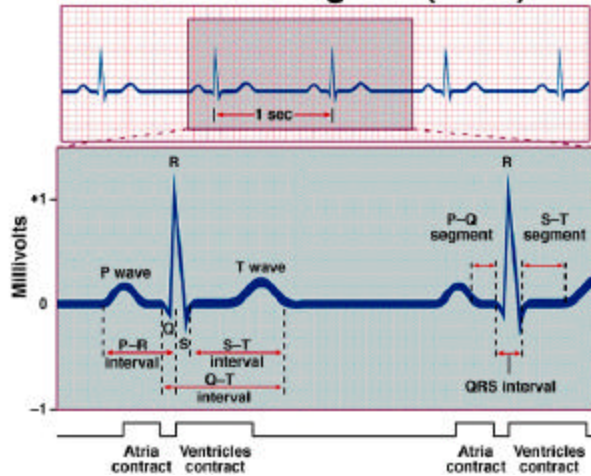


1. Blood from body via VENA CAVA to RIGHT ATRIUM
2. RIGHT ATRIUM contracts, blood moves from the RIGHT ATRIUM to the RIGHT VENTRICLE via the RIGHT ATRIOVENTRICULAR VALVE
3. RIGHT VENTRICLE contracts. Blood moves from the RIGHT VENTRICLE to PULMONARY ARTERY via the PULMONARY SEMILUNAR VALVE to lung.
4. Blood returns from lung via PULMONARY VEIN to LEFT ATRIUM.
5. LEFT ATRIUM contracts. Blood moves to LEFT VENTRICLE via LEFT ATRIOVENTRICULAR VALVE.
6. LEFT VENTRICLE contracts. Blood moves from LEFT VENTRICLE to AORTA via the AORTIC SEMILUNAR VALVE to body.

Cardiac Conduction System

Def. - group of cardiac muscle cells that generate and trans. Elec impulses to reg. Heart contractions
ECG (EKG - kardo in German)

Electrocardiogram (ECG)



P wave - atria depolarizes

QRS - Ventricle depolarizes

T wave - ventricle repolarizes

Irregularities

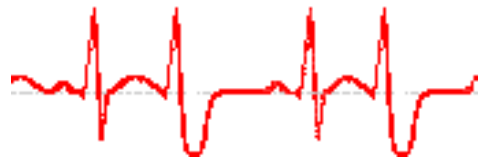
Bradycardia - Long interRight ventricleal between beats. May indicate shock.



a. Ventricular fibrillations - Irregular, weak heartbeat. Common result of a heart attack. Will cause death if not corrected.



b. Premature Ventricular Complexes (PVC's) - Extra ventricular contractions occur in the normal sinus rhythm. Most common irregularity in otherwise healthy people.



c. Asystole - No electrical activity at all. No attempt to contract.



Anatomy - Cardiac Conduction System

a) Sinoatrial Node

1) Loc in superior wall of rt. atrium

2) "pacemaker" - generate impulses as per brain & chemicals. Directly control atria (p wave). Relay to AV node via Purkinje Fibers.

b) Atrioventricular Node

1) loc in inferior wall of rt atrium

2) "Substation" Generate impulse (r wave) to ventricles as per SA node

Heart Sounds

a. Lubb - Dubb

b. Origins of sounds

1) Lubb - AV valves closing (stronger)

2) Dubb - SL valves closing

c. Murmur - leaky valve. Reduces efficiency and stresses heart. Degree varies. Many self correct

Cardiac Output

a. approx 5 - 6 L/min = total volume

Stroke volume = 70ml / beat

Factors affecting heart rate

a. Physical condition (illness, injury)

Physical Activity

Physical Fitness

c. Amount of body fat (more fat, more body)

d. Emotional state

e. Age

1) 140 - birth

2) 120 - 1 yr

3) 90 - 10 yr

f. Sex (male slower than female)

g. Misc (drugs, altitude, sleep)

Regulation of Heart rate

NeRight ventricleous regulation (Vagus NeRight ventriclee)

1) Parasympathetic - decrease

2) Sympathetic - increase

Chemical Regulation

1) Hormones

a) Epinephrine (adrenaline) - temp increase

b) Thyroxin - long term metabolic rate

2) Drugs

a) Caffeine, amphetamines - increase

b) Nicotine: double whammy - inc HR & vasoconstriction

Factors maintaining arterial circulation

1. Pumping of heart
2. Elasticity of arteries
3. Vasoconstriction / vasodilation
4. Peripheral resistance
 - a. *prob - blood slows due to friction, which would soon become greater than pressure.*
 - b. *solution - BV narrow with incr distance from heart. Reduc. Diameter increases velocity to compensate.*

Factors maintaining venous circ.

1. Work of the heart
 - a. *pressure in venules*
 - b. *suction near the heart*

Gravity in upper body

Valves - assists in lower body. Keeps blood from backsliding during diastole'.

Muscle Contractions

Blood velocity and BP

Arteries: High - High

Capillaries: Low - Low

Veins: Increasing - decreasing

Pulse

1. The momentary stretching of arterial walls with systole'.
2. Can be taken at any superficial artery.
3. Characteristics
 - a. *Rate*
 - b. *Strength*
 - c. *Regularity*

Blood Pressure

Def. The pushing of the blood on artery walls

1. only taken at brachial artery

Average

120 = systolic

80 = diastolic

4. Sphygmomanometer is the proper name of a BP cuff
5. Abnormalities
 - a. *Hypertension - High BP (risk of Heart attack, stroke)*
 - b. *Hypotension - low BP (dizziness, fainting, always tired)*
6. Factors affecting BP
 - a. *Health*
 - b. *Emotional Stress (inc)*

- Physical Activity*
- Physical Fitness*
- d. Age (inc with age)*
- e. Asleep or awake*

D. Circulatory Diseases

Heart attack

Def - anything that interrupts bloodflow to the heart muscle.

Cause

- a. blockage (blood clot, cholesterol)*
- b. ruptured blood vessel*

Results

Myocardial infarction - permanent dead spot in heart, forever weaker

Aneurism - bulging blood vessel in danger of bursting

Arteriosclerosis - "hardening of the arteries" mineral deposits reduce elasticity, due to natural aging changes.

Atherosclerosis - cholesterol and fat buildup inside arteries. Diet and lifestyle related

Varicose Veins - superficial veins in lower body swollen with blood due to loss of elasticity. Age related

Phlebitis -lymphatic vessels in lower body swollen with lymph due to loss of elasticity. Age related

E. The Blood

Characteristics

- a. Slightly denser & much more viscous than water.*
- b. pH - 7.35 - 7.45 = slightly basic*
- c. avg. 6 - 7 L for an adult*
- d. 8.5 - 9.1% of total body weight*
- e. 55% plasma, 45% corpuscles, solutes*

Functions

- a. Transport O₂, CO₂*
- b. Transport Nutrients, waste, hormones, etc*

Erythrocytes

- a. Shape - biconcave disc*
- b. Size - 20 microns*
- c. Structure - no DNA, lots of Hemoglobin*
- d. Numbers (in 1 ml³)*
 - 1. RBC - 5 million**

2. Exercise or altitude - increase

e. Functions

1. Bind and carry Oxygen
2. Control Blood pH Thickness

f. Life Span

1. 120 days maximum
2. Hematopoiesis - blood production. In marrow of Vert. & costals
3. Hemolysis - recycling of dead cells by spleen and liver.

g. Anemia

Any deficiency of functional RBC

1. Nutritional (iron or B12)
2. Hemorrhagic - physical loss of blood
3. Aplastic (Hemolytic) - auto immune disease

Leukocytes

Characteristics

1. Large
2. Most are ameboid
3. Produced in marrow
4. live 1 day - years

Numbers

1. 5000 - 9000 / 1 ml³

Abnormalities

Leukopenia - Too few, AIDS

Leukocytosis - too many WBC. Sign of infection.

Leukemia - Cancer of WBC

Three Main Groups

Granular Leukocytes

Characteristics

- 1) All Amoeboid
- 2) patrol body
- 3) Innate immunity

Types

- 1) Neutrophils - eat antigen, report to Helper T. most common
- 2) Eosinophils - allergies = worms?
- 3) Basophils - histamine for repair

Lymphocytes

Characteristics

- 1) Stationary
- 2) Aquired Immunity

Two Types

T - Cells

a) Helper - Antigen ID to B cell

b) Suppressor - regulates antibody production

c) Killer - destroys tagged target cells

B - Cells - In lymph nodes. Produce antibodies.
Remain as memory cells, giving immunity.

Monocytes

Location - In tissues. Never leave.

Function - On site defenses. Slow invasion, call for help.

4. Platelets

Structure - Protein Koosh Ball

Function - clotting of blood

Mechanism

a. Cascade Reaction , Multiple failsafes.

b. Non reversible.

c. Koosh ball platelets unravel. Fibers bind to other platelets forming a mesh patch.

Blood type

Types

A

B

AB

O

Rhesus (Rh) factor

Compatibility

1. "Nothing Foreign"

Universal Donor = O-

Universal Recipient = AB+