Chap 2: Blood Circulatory System of Man

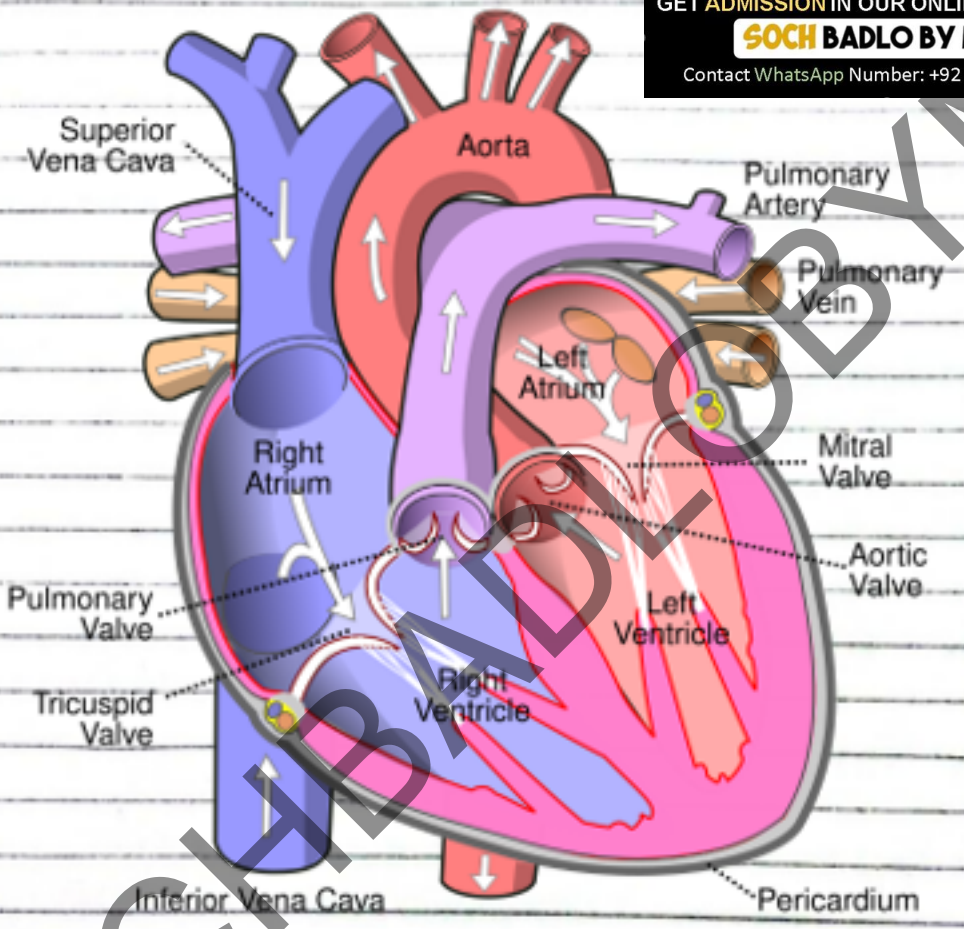
Topic:- Human heart (lecture 01)

Components / Characteristics of blood Circulatory System.

↳ Circulatory Pump: Heart

↳ Circulatory Fluid: Blood

↳ Circulatory vessels: (Arteries, veins, Capillaries)



* Structure & Function of Heart:-

location:- • Mediastenum
• Thoracic Cavity

Pericardium → • Prevent the heart from over expansion
• Place the heart in its position
• Protection
• Provides Lubrication

↓
Pericardial fluid/
Serous fluid. →

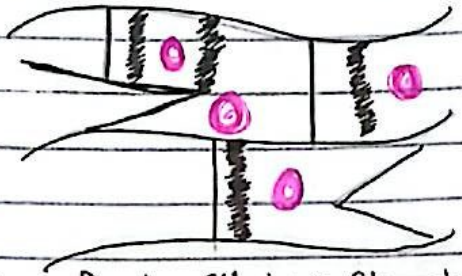
✱ Heart wall :-

Consists of three layers :-

↳ Epicardium :- (outer most layer made up of Connective Tissues)

↳ Myocardium :- (middle layer made up of Cardiac muscles)

↳ Endocardium :- Inner layer, endothelium tissue.



→ Striated / involuntary muscles

✱ Atria - Blood - Collecting Chambers (Cavae)

✱ Ventricle - Blood distributing Chamber.

Heartbeat: lub-- dupp--

↳ Right Ventricle : Left Ventricle

1 : 3 (3 times thicker than right ventricle)

✱ Heart Values

↓

Atrioventricular valve (Present b/w atria & ventricle)

→ Left (Bicuspid/mitral valve)

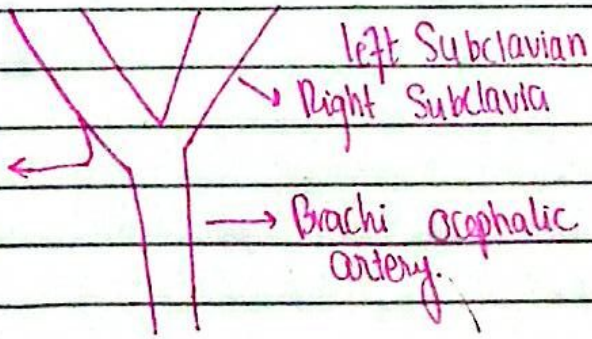
→ Right (Tricuspid valve.)

Semilunar valve (at the base of aorta & pulmonary trunk)

↓

Aortic Semilunar valve

Pulmonary Semilunar valve



✱ Arteries & Veins

① Arteries

- Aorta
- Pulmonary artery
- Brachiocephalic artery
- left Subclavian artery
- left Carotid artery
- Coronary artery (heart walls)

- Pulmonary veins (oxygenated blood)
- Inferior vena Cava
- Superior vena Cava
- Cardiac vein (blood back from heart walls) deoxygenated

Heart Valves (Flowchart)

- Atrioventricular valves present b/w atria & ventricle
  - left valve
    - ↳ b/w left Atria & ventricle
    - ↳ Bicuspid / Mitral valve
  - Right Av valve
    - ↳ b/w right Atria & ventricle.
- Semilunar valves
  - aortic Semilunar valve
    - ↳ at the base of aorta
  - pulmonary Semilunar valve
    - ↳ base of pulmonary trunk

↓ Tricuspid valve

Arteries of heart:-
↳ Aorta → brachiocephalic artery
→ left Carotid artery
→ left Subclavian artery.
↳ Pulmonary Artery (deoxygenated blood)
↳ Coronary Artery → heart walls.

* Right ventricle → Pulmonary trunk → lung.
* left ventricle → to the whole body.

* Control of Heart beat (Pg 30)
- one time collection of blood & one time pumping of blood by the:-

heart → heart beat.

- Sequences of events during the completion of one heart beat → Cardiac Cycle.
- The human heart is a remarkable organ.
beating over 100,000 times a day to circulate blood and oxygen throughout the body.
- This Continous pumping action is essential for:-

① delivering nutrients
② Removing waste Products
③ ensuring the proper functioning of all organs.

☆ The hearts rythym is Controlled by:
Certain electrical impulses, and even when seperated from the body it Can Continues to beat.

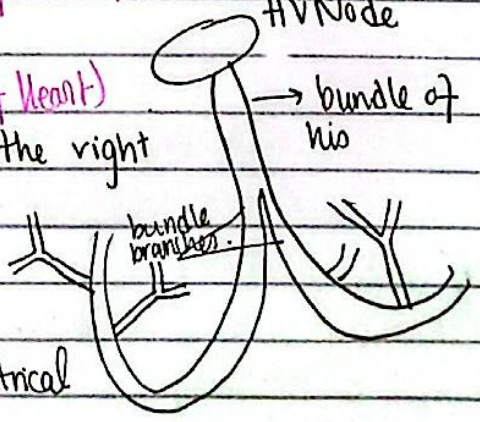
EVENTS OF CARDIAC CYCLE

Systole (contraction) (shrink)	AV- Valve	diastole (relaxation) (expand)
↳ Atrial diastole	Partially open	Semilunar valve partially open
↳ Atrial Systole	Completely open	Same.
↳ Ventricular Systole (close – dub)		
↳ Ventricular diastole	Completely open (suddenly close (dub)	

☆ Conduction System of the Human heart.. (Pg 32)
☆ The System which Control the Cardiac Cycle or Heart-beat.

⟹ Components:-
↳ Sino atrial node (SA Node/pacemaker of heart)
↳ ~~Arto~~ Atro ventricular node (AV Node)
↳ Atro ventricular bundles (Bundle of his)
↳ Bundle branches
↳ Conducting myofibril (Purkinji fibers)

☆ Sino atrial node (SA Node/ Pacemaker of Heart)
- It is Situated in the upper wall of the right atrium
- It Consists of clusters of modified Cardiac fibres.
- Modified for the generation of electrical impulse.



- Heart is myogenic
  i.e. impulses for the Contraction & relaxation originates from within the heart
  ↳ internal factors

✗ Mechanism of the Conducting System of the heart:

SA Node (Pacemaker) → Atrial wall → Atrial Contraction (Atrial Systol)
↓ 0.04 Sec
AV Node → Bundle of His
↓
Bundle branches
↓
Purkinji Fibres → ventricle wall → Ventricle Contract. (Ventricle Systol)
0.11 Sec

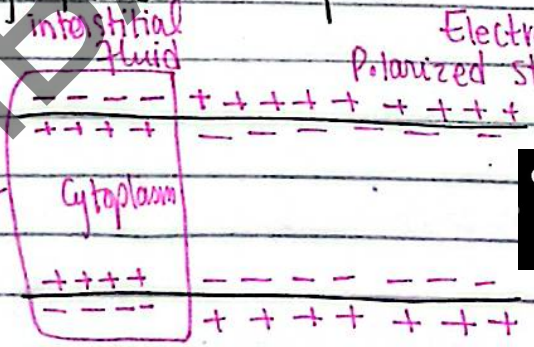
✗ SA Node = wave of depolarization = Atrial Systol

✗ AV Node = wave of depolarization = Ventricular Systol.

✗ AV Node = wave of repolarization = Ventricular diastol.

Atrial & Ventricular diastol - Depolarized state
↳ filling of blood ↳ Impulse

⇒ Diagram:

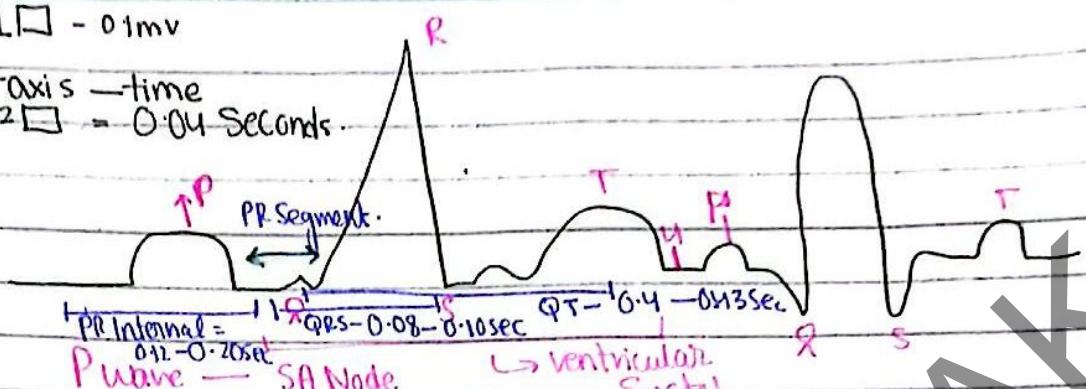


~~SA Node~~ ELECTROCARDIOGRAM (ECG)

↳ Graphical representation of electrical Activities of SA Nodes and AV Nodes in Cardiac Cycle.

↳ useful in the diagnoses of various Abnormalities in heart functioning.

Y-axis →
1□ - 0.1mv
X-axis — time
2□ = 0.04 Seconds.



P wave — SA Node
↳ Atrial depolarization
↳ denotes a wave of depolarization Spread from SA Node and is conducted throughout the Atrial wall.
[Causes Atrial Systol]

↳ Ventricular Systol.

-★ QRS Complex :-
□ Ventricular depolarization
↳ denotes the wave of depolarization Spread from the AV Node & is Conducted, through the walls of the ventricle.
(Causes ventricular Systol)

Flow-Chart :-
AV → bundle of Hiss → bundle branches → Purkinji fibres
Spread in the walls of ventricles

⇒ T-Wave :-
Ventricular Repolarization.
↳ denotes the wave of repolarization Spreading from the AV Node & is Conducted throughout the wall ventricles. [Also Causes ventricular Systol]

★ Segment :- Region b/w two waves
↳ ST Segment :-
Starts at the end of QRS Complex & ends at the Start of T wave.
PR Segment - Starts from the end of P wave and ends at the Start of QRS Complex.

Intervals:- An Intervals in an ECG is a duration of time that includes one Segment and one or more waves.

↳ PR (or PQ) Interval Starts at the Start P wave and ends at the Start of QRS.

PR Interval = P wave + PR Segment

- QRS ~~Seg~~ Interval:- Covers the QRS Complex from beginning to end.
- QT Interval:- Starts at the Start of QRS and ends at the end of T wave. It denotes the electrical Systole of Ventricles.

⟹ Role of Arterioles in Vasoconstriction ⟸ & Vasodilation ⟸

medulla → High BP → Smooth muscle relax → Vasodilation (expansion in arteries)

BP ↓ ↕ → Vasoconstriction (Constriction in arteries) → Smooth muscle Contract.

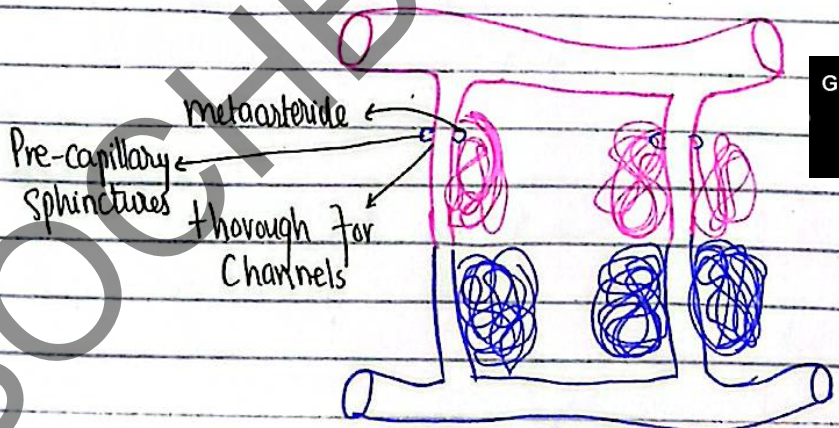
⟹ Epinephrine / Adrenaline → Vasodilator (skeletal muscles)

⟹ Norepinephrine / Noradrenaline → Vasoconstrictor (GIT)

↳ Kinins (Histamine → Vasodilator)

↳ prostglandin → normally → (Vasodilator but Some times acts as Vaso-Constrict)

Topic: ROLE OF PRE-CAPILLARY SPHINCTURE



↳ Vasodilation is the widening of blood vessels, which increases blood flow and lowers blood pressure.

↳ Vasoconstriction is the narrowing of blood vessels, which decreases blood flow & raises blood pressure.

↳ Precapillary Sphincters are tiny rings of smooth muscles at the entrance to the capillary beds. They act as valves that control blood flow into the capillaries.
↳ main job is to direct blood to the tissues that need it the most.

Topic:- Pathway of blood through pulmonary & Systemic Circulation.

Heart → double circuit heart (double pump)

⟹ Pulmonary Circulation (b/w hearts & lungs)
pumping of deoxygenated blood from heart to lungs & then collection of oxygenated blood from lungs to heart.

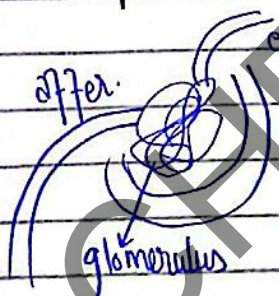
⟹ Systemic Circulation:- (b/w heart & body tissues)
pumping of oxygenated blood from heart to body tissue/system and the collection of deoxygenated from body tissue/system to heart.

Coronary artery —blood supply→ heart walls
Cardiac veins —collect blood→ from heart
↓ Converge.
Coronary Sinus → right Atrium

lungs
Heart
other systems

⟹ Renal Circulation:-
renal artery → afferent arteriole → glomerular arteriole → efferent arteriole → peritubular capillaries → vasa recta → renal vein → out of kidney

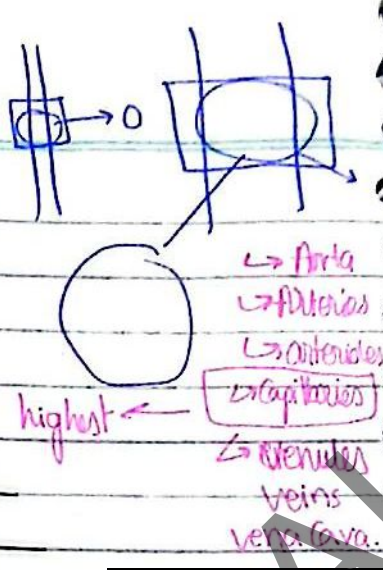
✦ Hepatic Portal System:-



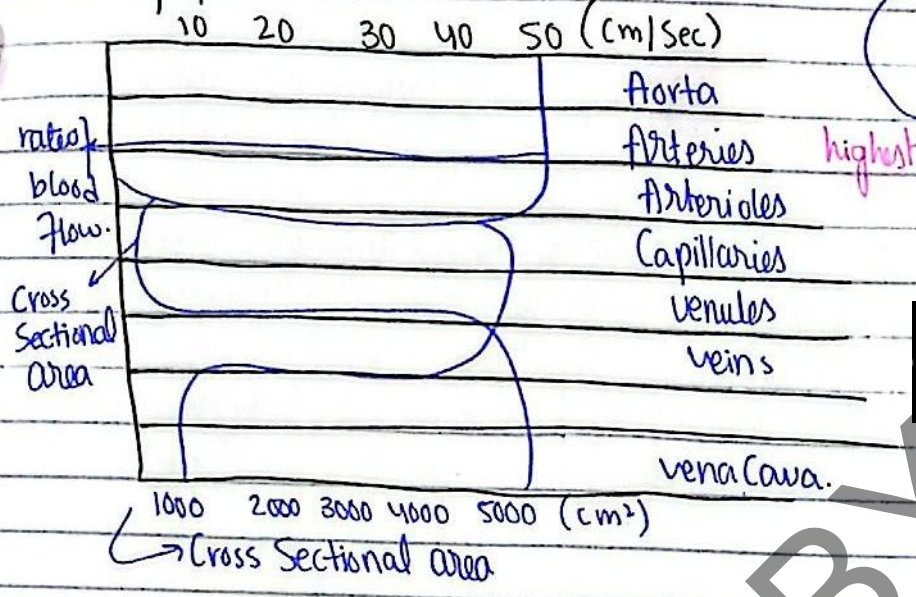
Inferior Vena Cava
↑ Hepatic vein
liver
Hepatic portal vein (all veins of GIT)
Hepatic Artery Aorta.

Topic:- Rate of blood flow in blood vessels.
Cardiac Output (out) → flow of blood in one heart beat.
Stroke Volume → flow of blood in one heart beat.
Heart Rate → No. of heart beats in one minutes
Cardiac Output = Stroke Volume x Heart Rate

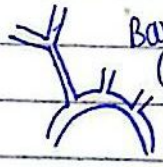
Rate of blood flow = $\frac{1}{\text{Total Cross Sectional area of vessel.}}$



⟹ Graph



TOPIC :- Blood Pressure & Its Regulation



Baroreceptors / strech Receptors

high pressure receptors
→ Carotid Sinus
→ Atria Walls
→ Walls of Aorta

low pressure / volume receptors.
→ wall of Atria
→ Carotid arteries

⟹ ~~Eat~~ Carotid Arteries
↳ Epinephrine (high BP) (vasodilator) → Skeletal muscle. → GIT.
↳ Nor Epinephrine (vasoconstrictor) — high BP
↳ Kinins (Histamin) → vasodilator
↳ Protglandin (vasodilator) occationally (vasoconstrictor)

✱ Medulla :-
Heart Rate ↓
Stroke Volume ↓
Cardiac Input ↓

High BP → Vaso dilation (Expansion in arteries)
low BP → Vasoconstriction (contraction in arteries)

Topic- Lymphatic System (Pg 45)

→ The type of circulatory System which is responsible for returning the lost part blood back to the blood Circulatory System.
↳ Tissue fluid / interstitial fluid

loss - 30L / 24hr
return - 27L / 24hr
remaining 3L → Return
↳ lymphatic System.

Plasma (in Capillaries) → Interstitial fluid (interstitial Space) → lymph (lymph vessels)

The lymphatic System.

→ lymph Nodes / lymphoid masses

Mainly lymph Node → Axilla (armpits)
Neck
Groin (area b/w legs)

⇒ lymph vessel
↳ lymph Capillaries (lacteal)
↳ Small lymph vessels
↳ larger lymph vessel
↳ largest lymph vessel (Thoracic duct)
↓
Right Subclavian vein
↓
Blood Circulatory System

↳ large lymph Nodes:-

↳ Adenoid → Side of nasal Cavity

↳ Tonsil (Neck)

↳ thymus (Chest)

↳ Spleen (Abdominal Cavity)