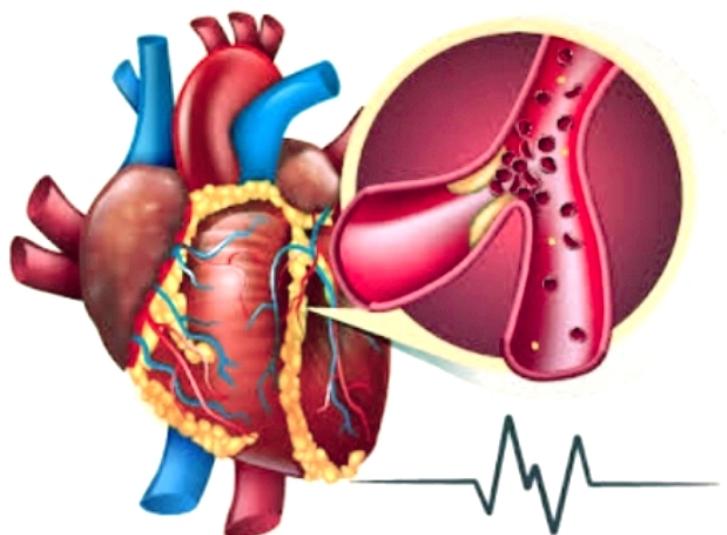




BODY FLUIDS & CIRCULATION

Class 11 Study Notes



BODY FLUID



CIRCULATION

- * Study circulatory system is called angiology.
- * It includes blood vascular system or circulatory system.
- * Father of angiology William Harvey.
- * Circulatory sys. is of two type :-

1. open circulatory

- ▲ Blood pumped by heart and passed through blood vessels into an open space ie called lacunae/sinus. Exchange of nutrient directly b/w blood & tissue.
- ▲ In this blood is directly contact with body fluid & tissue. arthropodes, mollusca.
- ▲ Fluid following in this system is called haemo lymph.
- ▲ No respiratory pigment.
- ▲ No transport of gases
- ▲ Vol of blood cont. control
- ▲ Blood flow is slow, spider

2. close circulation

- ▲ Blood pumped by heart & always circulated through a close network of blood vessels ie never open into sinus.
- ▲ Blood is not directly contact with body fluid of tissue. eg chondrocyte, and
- ▲ fluid flow in close system & it is called blood.
- ▲ Respiratory pigment present.
- ▲ Transport of gases.
- ▲ Volume of blood can control by contraction & relaxation of blood vessels.
- ▲ blood flow is quick
- ▲ Nutrients are exchange via tissue fluid.
- ▲ Capillary & vein is present.

BLOOD

(55%) Plasma

Formed Elements (45%)

Bloocell

WBC

RBC

Thrombocyte

* On the basis of circulatory system two types of system

1. Lymphatic System
2. Blood Circulatory System

Lymphatic system:-

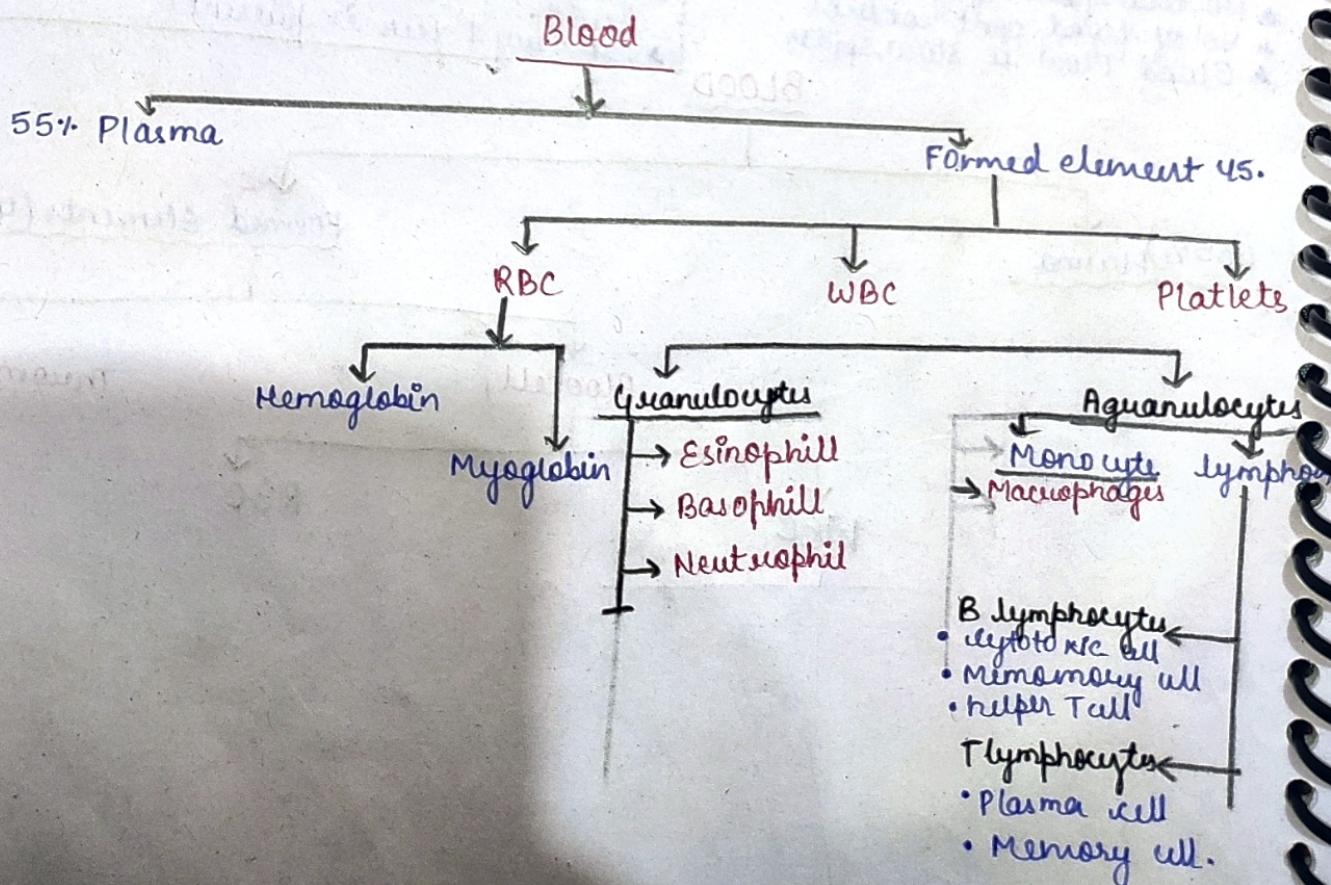
Tissue fluid, lymph, lymph vessels, lymph node.
Lymphatic organ.

Blood Circulatory :-

Blood, blood vessels, heart.

Blood.

- Study of blood is called haematology.
- Formation of blood is called haemopoiesis.
- PH Value of blood - 7.4
- Colour red
- blood influence 7 to 8% weight of human body.
- \approx 4 to 5 litre blood in female
- 5 to 6 l in male.
- blood consist of two composition:-



Plasma:-

- * Pale yellow colour viscous fluid. straw coloured.
- * It consist of 50% total blood.
- * 92 to 90 plasma is water.
- * 6 to 8 % are proteins
- * in plasma 3 diff types of proteins are found.
 - **fibrogen** :- blood clotting factor produced by liver.
 - **globulins** :- primary helps as defense mechanism α, β, γ globulines are types
 - **Albumins** :- help in Osmotic balance they main Osmotic pressure, bp & bv.

- α globulines is synthesized in liver
- It is responsible for digestion of specific protein digesting enzyme.
- β globulines is also synthesized in liver.
- It is responsible for binding of iron with body content.

- γ globulines produce by immune system of cell ie lymphocytes

4 plasma cell. immune response in body.

* Plasma contain Na^+ , Mg^{2+} , NaCl (salt) Ca^{2+} , HCO_3^- , Cl^-

FORMED ELEMENTS

* It most abundant cells in the blood.

* healthy adult human has an average 5 to 5.5 million cm^{-3} or mm^{-3} .

* RBC found in red bone marrow in adults.

* RBC contain iron containing pigment haemoglobin, haemoglobin actively involved in transportation of O_2 & CO_2 .

* in embryonic stage RBC synthesised in liver + spleen (Mesodermal in origin)

* life span of RBC = 120 days.

* after that they destroy in spleen ie why spleen is also called (graveyard of RBC)

* RBC are without nucleus are denser in most of mammals
4 biconcave in shape.

* Camel lamb RBC have whose shape is oval.

* deficiency of RBC Anemia

* In an adult human avg haemoglobin 12 to 16 gm / 1000 ml

WBC

- * Coloured substance of blood cell due to absence of haemoglobin.
- * It is nucleated & relatively lesser in number.
- * Average WBC count are $6000 \text{ to } 8000 \text{ mm}^3$
- * Life span of WBC is shorter 20-25 days.

Types

1. Granulocytes

- Eosinophil Acidophil (
- Basophil
- Neutrophil
or
heterophil

2. agranulocytes

- Monocytes (6 to 8 %)
- lymphocytes (20 to 25 %)
 B lymphocytes
 T lymphocytes

* Acidophil :-

- 2 to 3 %.
- resistance from infection and associated with allergic reaction.
- ★ → Bitubed nucleus.
- formed inside bone marrow.
- increase its number during allergy.
- 4 to 5 days in tissue.
- 4 to 8 hours in blood.

* Basophil :-

- 0.5 to 1 %.
- releases heparin and histamin, serotonin
- 4 to 8 hours in blood.
- trilobed

* Neutrophil :-

- 60 to 65 %.
- It secretes histamin, serotonin, heparin.
- It responds to inflammatory reactions.
- 4 to 5 days in tissue.
- 4 to 8 hours in blood.
- formed inside bone marrow.
 Shape:- multinucleated.

* Monocytes :-

\rightarrow 6 to 8 %.

- \rightarrow phagocytic cell
- \rightarrow Destroy foreign organism enters in our body.
- \rightarrow 10 to 20 hours in blood.
- \rightarrow formed inside bone marrow.
- \rightarrow Bean shape β having large shape.

* Lymphocytes :-

\rightarrow 20 to 25 %.

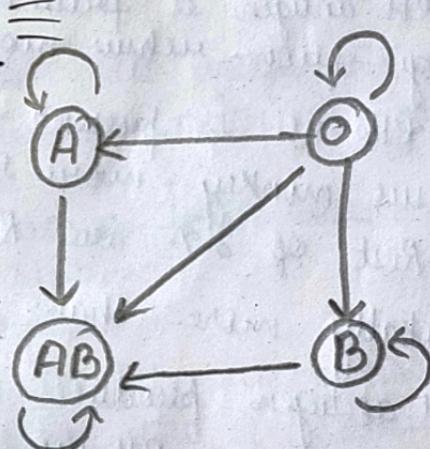
- \rightarrow It is of two types
- \rightarrow immunity response
- \rightarrow round nucleus.
- \rightarrow secrete antibodies
- \rightarrow formed in lymph nodes, spleen, thymus, tonsil.

Platlets, Thrombocytes

- \rightarrow Round and oval & non nucleated.
- \rightarrow These are cell fragment that are produced from megakaryocytes (special cell in bone marrow).
- \rightarrow formation of platlets is called megakaryolyysis.
- \rightarrow $1,50,000, 3,50,000, \text{ mm}^3$
- \rightarrow It release various substance in which most are involved in blood clotting.
- \rightarrow decrease in number cause Thrombopenia disorder ie excessive blood loss during injuries.

BLOOD GROUP

- \rightarrow discovered by Karl Landsteiner.
- \rightarrow blood types or groups are A, B, AB, O
- \rightarrow antigen ie present on surface of RBC is the reason for Various type of B.G in human.
- \rightarrow All human having only 2 type of antibody ie A & B.
- \rightarrow antigen :- specific protein present on plasma (surface) that secret antibody



antibody :- It specific glycoprotein secreted by blood (Lymphocyte) against to antigen.

\rightarrow antigen is produce by special gene ie called isohitinine gene Ig / Ig / i

Blood group	antigen	antibody	genotype	
A	A	B	$I^A I^A / I^A I^B$	Dominant
B	B	A	$I^B I^B / I^B I^O$	Dominant
AB	AB	Nil	$I^A I^B$	
O	Nil	A & B	$I^O I^O / i$	Recessive

O- universal donor.

AB- universal acceptor.

- during blood transfusion any body blood can't be use
- for blood transfusion donor antigen shouldn't match with recipient antibody.

RH factor

- RH antigen was first discovered from rhesus monkey.
- RH antigen abundantly found in human on the RBC.
- If RH antigen is present then it is called RH +ve. that means origin from rhesus monkey.
- If RH -ve is present then their originated from other than Rhesus monkey. more than 97% people of india are RH +ve & Rest of 3% are RH -ve.
- globally more than 80% are RH +ve & rest of 20% are RH -ve
- RH antigen produce by dominant gene so if one of the parent is RH +ve then offspring must be RH +ve
- In special case of RH Incompatibility mismatched has been observed b/w the RH -ve blood group of a pregnant women with RH +ve blood group of the fetus.
- If father is +ve & q is +ve offspring must be RH +ve & RH +ve is dominant, in this 1st delivery would be normal & during child birth blood of foetus & mother blood can mix so mother start producing antibody against RH +ve of this antigen & antibody enters from

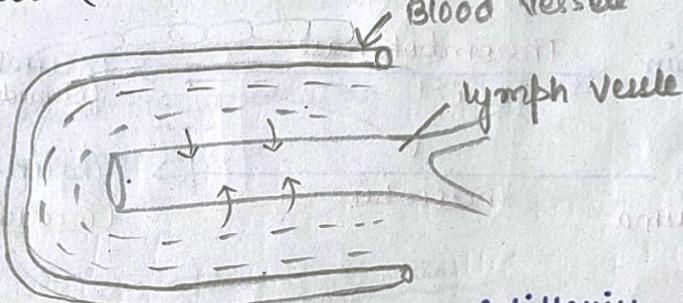
foetus through placenta in 2nd pregnancy & then destroy the RBC of foetus due to this death of foetus occur. If it is called erythroblastosis foetus.

Precaution

- at the time of 1st child birth both mother & child bG test and then we should vaccinate anti RH antibody to the mother after 1st delivery.

LYMPH (Tissue fluid)

- Lymphs are actually collection of interstitial fluid. So it also called interstitial fluid.
- Lymph = Blood - (RBC + Platelets + Macroprotein)
Blood Vessel

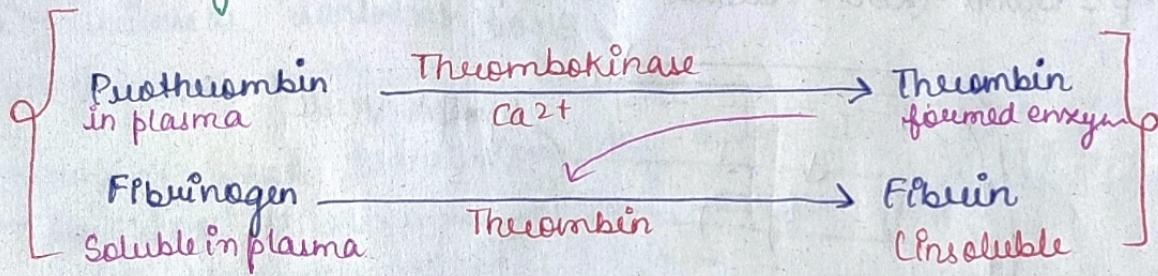


- during blood circulation through capillaries in the tissue small amount of water & water soluble substance are move into the space b/w the cell of tissue i.e. they release large amount of clotting factor (protein) except RBC, platelets & Macroprotein.
- Lymph is colourless.
- Lymph has some constituent like blood but accept RMP.
- It helps in transportation of mineral, nutrient gases & waste material.
- Lymphatic fluid are circulated through lymph vessels & its network is called lymphatic system.
- It is responsible for immune response.
- Large lymph vessels is called lacteals responsible for fat absorption. Through intestinal villi is present on lacteal.

Blood Coagulation

- * Blood clotting occurs when any injury (cut or wound) occurs
- When blood flows.
- * bleeding time = 2 to 3 minutes
- * clotting time = 2 to 8 minutes
- * If BC not occurs then the condition is caused a disease called **haemophilia**.
- * Some time delayed into BC also considered as haemophilia & if it is repeated continuously.

Cascading or multistep process of BC



- In injury blood platelet release regulation promoting substance is called thromboplastin.
- Thromboplastin helps in formation enzyme complex is called Thrombokinase.
- Thromboenzyme complex is formed by series of linked enzyme reaction. i.e. called cascading process.
- In cascading it involves number of factors in the plasma.
- In plasma clotting factor ~~are~~ protein (enzyme) are occur in inactive state.
- Ca²⁺ major role for activation & action of thrombin fibrin form a network of thread which traps dead & degraded formed element of blood to form the BC.
- BC seal the wound area or lock the wound in the blood vessel to stop bleeding.
- Vitamin K is necessary for synthesis of clotting factor.

→ during clotting pale yellow colour fluid comes out through injuries after some time & it is called serum.

→ B.C factors are

factor I :- fibrinogen

factor II :- Prothrombin

III :- Thromboplastin

IV :- Calcium ion

V :- labile factor

VII :- Stable factor, pro convertin

VIII :- Antihaemophilic A

IX :- Xmas, Antihaemophilic B (PTC)

X :- Stenon Power factor

XI :- Plasma Thromboplastin (PTC) Antihaemophilic C

XII :- Hageman factor

XIII :- fibrin stabilizing factor

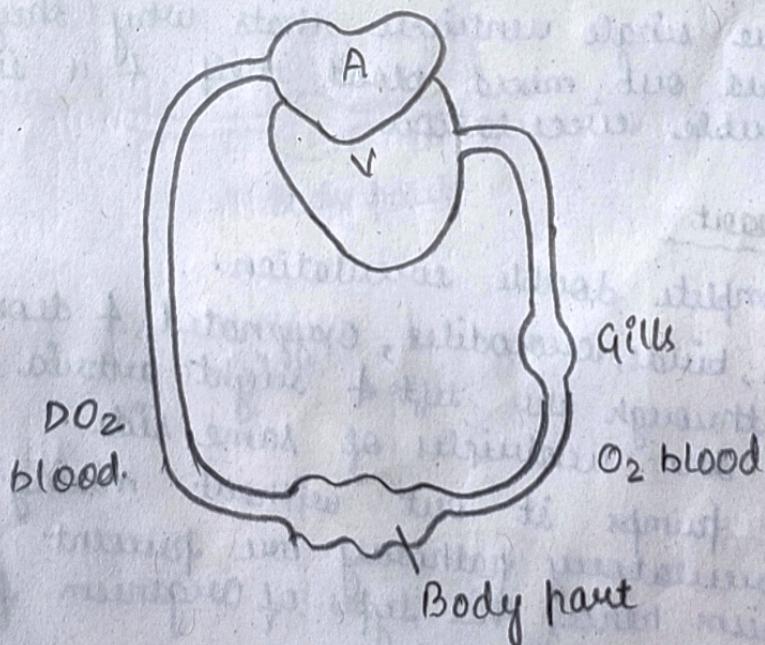
Circulatory pathway

1. 2 chambered

2. 3 chambered

3. 4 chambered

→ 2 chambered heart having 1 Aorta + 1 Ventricle

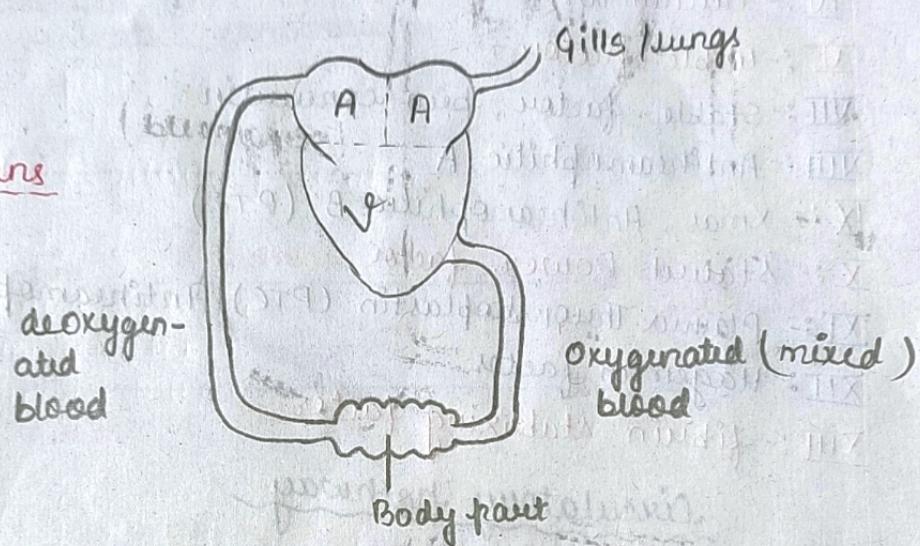


→ in fishes the heart pumps out deoxygenated blood which is oxygenated by gills & supply to the body part where deoxygenated blood return to heart & it is called single circulation

3 chambered heart

- * 2 Atria
- * 1 Ventricle

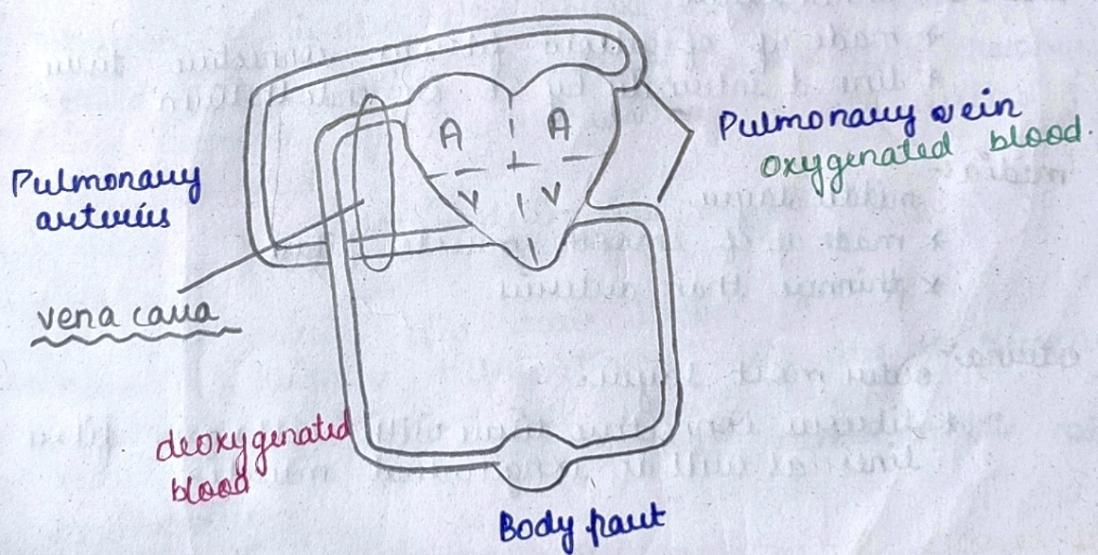
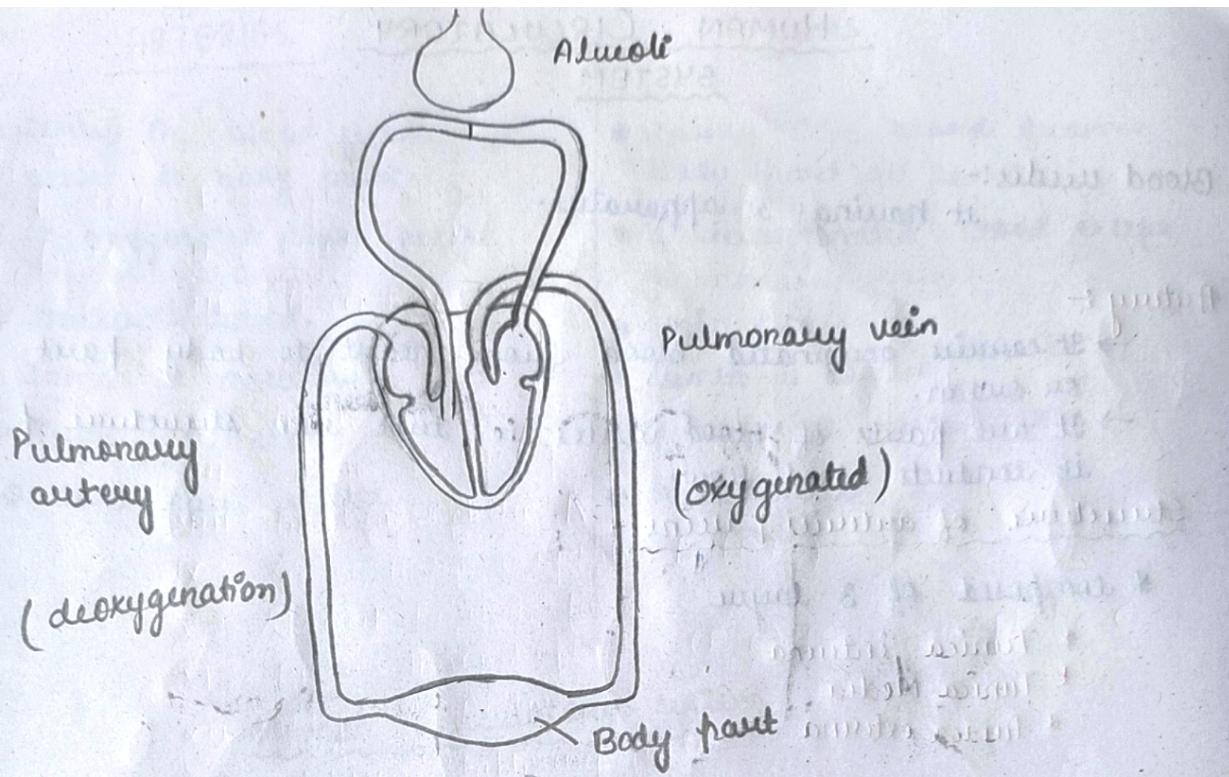
amphibians



- 3 chambered heart having incomplete double circulation except crocodile.
- In amphibians & reptiles the left ~~right~~ atrium receive oxygenated blood from gills, lungs or skin.
- Right atrium receive deoxygenated blood from the body parts.
- since they have single ventricle that's why they get mixed up. it is pumped out mixed blood itself & it is called incomplete double circulation

4 chambered heart

- it having complete double circulation.
- in mammalians, birds, crocodiles, oxygenated & deoxygenated blood receives through the left & right atria respectively.
- passes on to the ventricles of same side.
- the ventricles pump it out without mixing of.
- i.e. 2 separate circulatory pathway are present in this types of organism hence, this type of organism follow complete double circulation path.



HUMAN CIRCULATORY SYSTEM

Blood vessels:-
it having 3 apparatus.

Artery :-

- It carries oxygenated blood from heart to body part or organ.
- It are parts of blood vessels ie tube like structure & it conducts blood flow.

Structure of arteries & veins :-

* composed of 3 layers

- * Tunica intima
- * Tunica Media
- * Tunica externa

• Tunica intima :- inner layer

- * made up of yellow fibrous connective tissue
- * lined internally by SE or endothelium

• Tunica media :- middle layer

- * made up of smooth muscle fibre
- * thinner than arteries

• Tunica externa :- outer most layer.

- * fibrous connective tissue with collagen fibre lines as well as longitudinal muscle.

Capillary :-

- formed by joining of arterioles & venules.
- i.e. it forms network like structure b/w arteries & veins.
- it consist of only one layer ie tunica intima or one layer.
- it has thin wall having minutes & pores

ARTERIES

- carry O₂ blood from heart to body part.
- it oxygenated blood except pulmonary artery
- thicker & hard.
- lumen is narrow
- deeply in skin
- dont have valve

VEINS

- carry CO₂ blood from body part to heart.
- it deoxygenated blood except pulmonary veins.
- thin & soft.
- lumen is wider
- superficial below skin
- have valve.

Human circulatory system

- human CS is also called blood vascular system.
- Blood vascular system consist of a muscular chambered heart. ie a network of closed branching blood vessels & fluid are circulated
- human heart - endomesodermal in origin
- 300gm.
- Thoracic cavity b/w two lungs.
- heart is slightly tilted toward left due to presence of cardiac notch toward left ventricle
- heart is covered by double wall membrane. ie called pericardium.
- Pericardium →

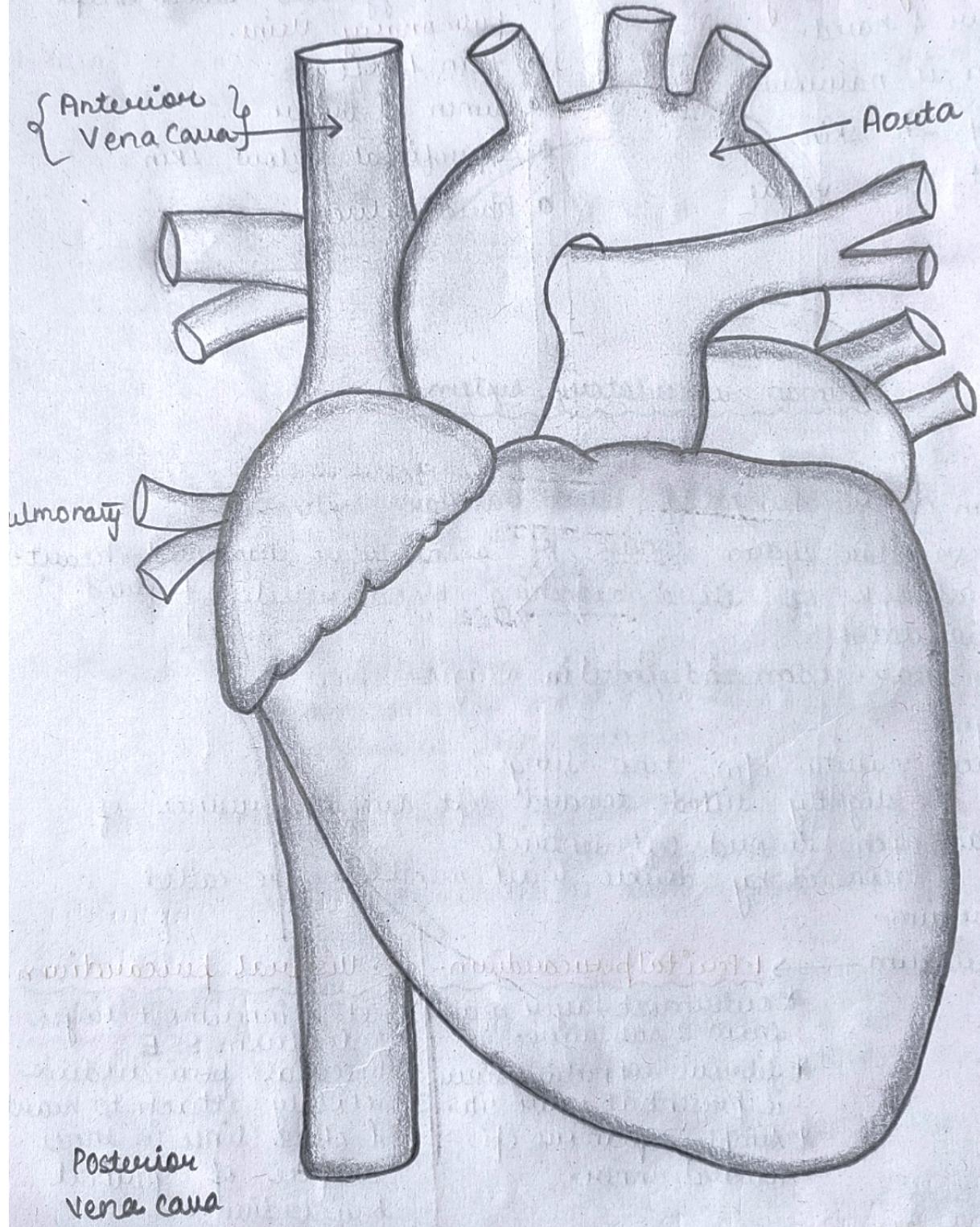
1. Peritoneal pericardium.
- * outermost layer made from 2 sublayer.
 - * fibrous connective tissue ie present at outer site.
 - * simple squamous epi toward inner.

2. Visceral pericardium.

- * it is innermost layer made from SSE
- * Visceral pericardium closely attach to heart & other lines ie inner surface of parietal pericardium.

b/w the parietal & visceral PC the space ie called Pericardium cavity / space
Pericardial cavity filled with fluid Pericardial fluid.

Pericardial fluid :-
protect from jerk
friction & provide
moister to heart &
also help in preventing
collapse of 2 layers.



internal structure of heart :-

→ It consists of 3 layers.

1. Epicardium / exocardiun

→ outermost layer

→ mesodermal in origin made up of SSE.

2. Myo / Mesocardium.

→ present at middle.

→ It is also middle mesodermally derived.

→ made up of cardiac muscle, i.e. involuntary & striated muscle.

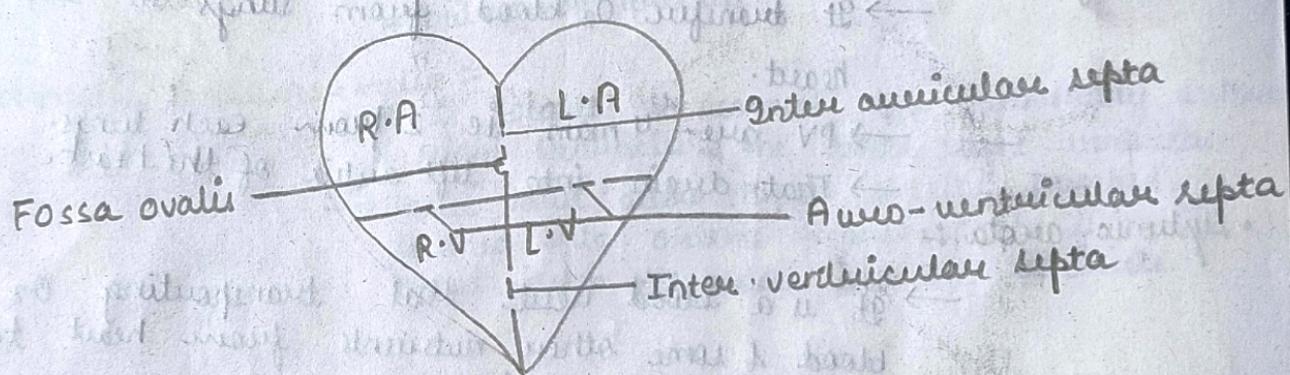
3. Endocardium.

→ It is innermost layer.

→ It is endodermally derived layer.

→ Made up of SSE

Heart septa



• Inter-atrial septa:- wall of tissue separate right & left atria

• Inter-ventricular septa:- wall of tissue that separate right & left ventricle i.e. lower chamber.

• Fossa ovalis:- depression in heart in right atrium.
made up of thin fibrous sheet of Foramen ovale.
Foramen ovale close on whole b/w right & left atria i.e. upper chamber heart. This ~~whole~~ exist in every one before birth but most oftenly close shortly after being born.

• Anti-ventricular septa:-
septa b/w left atrium & right left ventricle
right ventricle & left ventricle & these are mediated through various valves.

Pulmonary vein :-

return O_2 blood from myocardium back to the Right.

- Anterior Vena cava :- collect blood from anterior part of the body, head, neck, arms.
 - It is large vein which dO_2 blood into the right atrium of the heart. from upper half of the body
- Posterior Vena cava :-
 - collect blood from posterior part of body
 - it collects blood from 4 veins & return right atrium
- Pulmonary artery :-
 - collect deoxygenated blood from the RV to the lung.
- Pulmonary vein :-
 - It transfer O_2 blood from lungs to the heart.
 - PV are 4 main ie 2 from each lungs.
 - That drain into left atria of the heart.
- Systemic aorta :-
 - It is a blood vessel that transporting O_2 blood & some other nutrients from heart to the other organ & tissue.

* Valve is of 4 types

1. Hemiaurian valve :-

2. Eustachian valve :-

3. Pulmonary valve :-

4. Systematic semilunar valve :-

• Thebasium valve :-

It is present at opening of pulmonary vein
It control receiving of dO_2 blood from myocardial muscle.

Hemispherical valve:-

- Present in human absent in rabbit.
- Present at opening of anterior venae cavae.
- It allows passage of blood into right atrium.

Eustachian valve:- It is an embryological remnant of part of anterior vena cava.

- This is present at the junction of inferior vena cava & right atrium.
- Help in flow of O₂ blood through right atrium into left atria.

Pulmonary semilunar valve:-

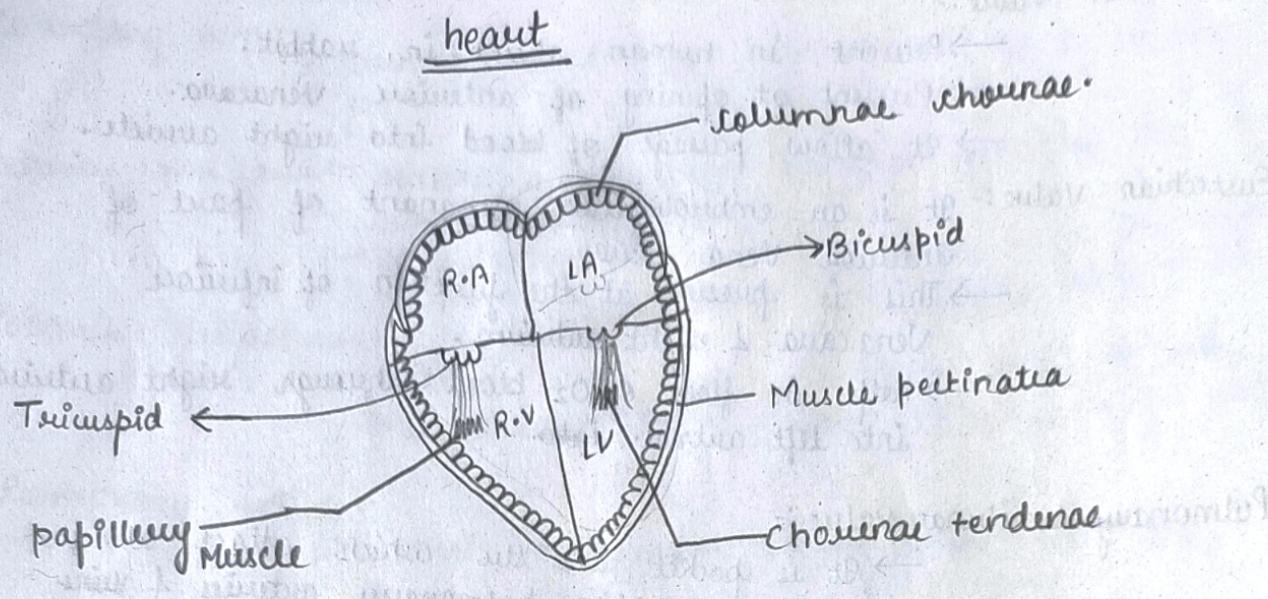
- It is pocket-like structure which attaches at the point at which pulmonary arteries & veins exit from the ventricles.
- It guards the opening b/w right ventricle & pulmonary arteries.

Systemic semilunar valve:-

- It is located at connect b/w pulmonary arteries & right ventricles & the aorta & right ventricle.
- These valves allow blood to be pumped forward into arteries & prevent backflow of blood from the arteries into the ventricle.

Bicuspid and tricuspid

- Bicuspid valve having 2 cusps, it regulates blood flow b/w L.A & L.V. It helps in preventing backflow of blood.
- Tricuspid valve has 3 cusps & is on the right side of the heart. It is b/w R.A & R.V. that help in preventing backflow of blood.



Muscle pectinate :- It is mainly found inside auricle as a rigid ~~or~~ or on the antero-lateral surface chamber with smooth internal surface.

→ It looks like teeth on a comb on contraction.

→ It is made up of pectinate muscle.

Papillary muscle:-

→ It is made up of thread fibrous tissue it anchors on hold with heart valve.

→ It rupture or damage through myocardial infarct or tissue death due to partial blood supply.

→ It holds coarctae tendinae to control cusp of the bi & tricusps valve.

Chorae tendinae :- (String)

→ It regulates / resemble like small string.

→ It play vital role in holding the atriо-ventricular valve in place while the heart is pumping blood.

→ made up of collagen fibre (80%) with elastin & endo ~~thelial~~ thelial ie (20%).

Columria Chonoma :-

- also called trabeculae carneae
- Its function is somehow similar to papillary muscle i.e. contraction pulls of chorda tendina which prevents inversion of the bicuspid & tricuspid valve, leakage of blood into auricle & back flow of blood from the ventricle into the atria.

- Left auricle receive O_2 blood from superior venae cavae or heart valves are used for backflow of blood.
- In auricle :- superior vena cava. guarded by hemispherical valve
 - inferior vena cava. guarded by eustachian valve
 - opening of coronary sinus guarded by thebasian valve.
- ★ • In left auricle valve is absent.
- In ventricle :- In R.V Pulmonary artery guarded by pulmonary semilunar valve i.e. tricuspid.
In L.V or aorta guarded by systemic semilunar valve or bicuspid.

Regulation of heart beat

- Sino atrial node or Pacemaker.
- It is cardiomuscular present at upper right column or recess of right auricle
- generate impulse at rate of 72 per minute so it regulate the rate of heart beat hence it is called pacemaker.
- A-V node Atrial ventricular node.
- Present lower left corner of right auricle
- receive impulse from SA node through internodal fibre & passes impulse toward ventricle.

Bundle of his :-

- Recive impulse from A.V node & moves toward ventricular wall.
- It is present at inner ventricular septum & divide into right & left fibre (ie purkinje fibre)

function of heart

heart beat :- rhythmic contraction & relaxation of heart is called heartbeat.

→ It consist of two part systol or ~~diastole~~ contraction.

→ systol or relaxation or repolarisation

→ heart beat is generally more infant, child & female & less in old age person

→ heartbeat stethoscope.

→ heartbeat inversly proportional to body size.

<u>Organism</u>	<u>heartbeat</u>
adult	72 per minute
child	100 per minute
infant	120 - 140
embryonic stage	160 per minute
frog	64 per minute
rabbit	210 per minute

regulation of heartbeat

→ Heart is self regulation site with the help of special cardiac nodal muscle so our heart is myogenic

→ It is regulated by two unit medulla oblongata. So centre for cardiac regulation which is present in medulla centre that regulate the heart beat through ANS.

- Cardiac accelerating system on sympathetic nervous system
 - * It increase rate of heartbeat by passing signal to SA node.
- Cardiac inhibitory system on parasympathetic nerve
 - * It decrease the rate of heartbeat by passing signal to the SA node.

Hormonal regulation of heart beat:-

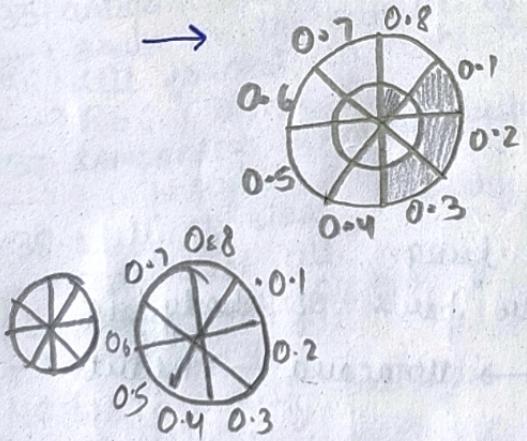
→ Sympathetic nerve fibre secrete the hormone ie sympathetic or noradrenaline which increase rate of heartbeat.

→ Parasympathetic nerve fibre that secrete acetylcholin which decrease rate of heartbeat.

→ Adrenaline from adrenal gland medulla & thyroxin from thyroid gland also increase ratio of heartbeat.

Cardiac Cycle

- The sequential event in the heart which cyclically repeated during heartbeat is called cardiac cycle.
- Cardiac cycle consist of following event
- contraction of auricle is auricular systole & thin relaxation is auricular diastole.
- contraction of ventricle is called ventricular systole their relaxation is ventricular diastole.
- Time for 1 cycle = $\frac{60}{72} = 0.8$.



Auricle	diastole	0.1
Ventricle	diastole	0.3

0.4

Stroke Volume:- Volume of blood pumped by each ventricle during cardiac cycle on ventricular systole.

→ It is 70 ml per cardiac cycle.

Cardiac output:- The volume of blood pump by each ventricle in a minute.

Total cardiac output = $70 \times 72 \approx 5000$
i.e. 5 liters blood pumped by our left ventricle to the different

X Body part in a minute

Portal system or portal circulation :-

In some organ their O_2 blood don't pass to heart via cava directly through their vein - then these are called portal circulation.

- in this organ vein divided into many venules & open into the vein of any other organ so their O_2 blood transported to other organ of the heart via vena cava.
- This type of circulation completed through portal circulation

It is of 3 types

1. Renal portal system.
2. hepatic portal system.
3. hypophyseal system.

o Renal portal system :-

- It is found in fleg.
- blood from lower parts of body ie legs, → kidney → venacava → heart.

o hepatic portal system :-

- found in mammals
- blood from elementary canal → spleen → pancreas → gall bladder → liver
- venacava → heart.

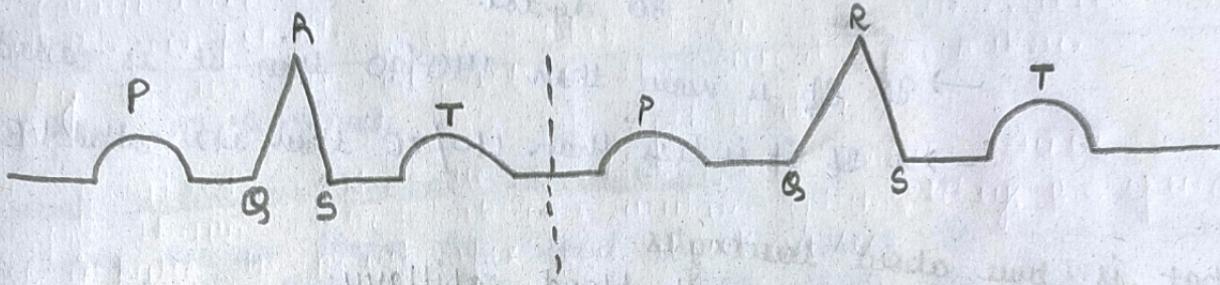
o hypophyseal system

- It is microcirculation process found in brain that connect hypothalamus with anterior pituitary.
- hypothalamus → pituitary → venacava → heart.

- Blood pressure :- Bp is pressure of circulating blood on the wall of blood vessels i.e. pressure exerted by blood flowing on the elastic wall of artery is called blood pressure.
- i.e. pressure exerted by blood flowing wall of artery can have variable pressure.
 - Bp cause due to contraction of the heart muscle.
 - Bp is measured sphygmomanometer bp gauge.
 - Normal bp $\frac{120}{80}$ systol
dystol.
 - If Bp is more than $140/90$ then it is called ↑ BP.
 - If it is less than $110/70$ then it is called ↓ BP.

ECG electrocardiogram

- It is a machine by which we obtain electrocardiogram
- Since we get graph of electrical activity of heart during cardiac cycle ie called ECG
- Used to detect functionality of different part of heart chamber.



→ each peak is identified with a letter P to T that represent a specific electrical activity of the heart.

• P-wave :- atrial electrical excitement (depolarisation) systole
→ contraction of atria

• Q,R,S wave :- wave complex ventricular depolarisation diastole
→ contraction start shortly after Q & marks the begining of the systole

• T wave :- ventricular repolarisation from excited to normal.
→ end of T wave marks the end of systole

→ By counting the no QRS complex in a given time period we can determine the heart beat rate of an individual.

→ If any deviation from usual graph shape, indicate a possible abnormalities or diseases

→ If it sound like pip pip...peeeeeeee..... that means heart arrest cardiac arrest occurs.

Heart sound.

→ Two types

- Get closer by bimupid & tricuspid.
- In ventricular systole
- Softer

Dub ❤

- Semilunar valve closer
- In ventricular diastole
- Louder.

Disease or disorder related with C.S

- Hypertension ↑ BP
 - Hypotension ↓ BP
 - Angina Pectoris → also called Ischemic chest pain.
 - symptom of acute chest in heart region
 - if cuspid having ↓ O₂ supply to the heart muscle mainly in coronary artery.
 - When deposition cholesterol in coronary artery occur more in middle age.
 - Angina occurs in both ♀ & ♂ in any age but most common in middle age.
 - Bypass surgery
 - Coronary artery bypass surgery or Bypass surgery is used to reduce or restore normal blood flow to an obstructed coronary artery.
- CAD Coronary artery disease :-
- It is caused due to deposition of calcium, fat, cholesterol & fibrous tissue in the coronary artery that make lumen narrow. It cause heart attack, heart failure & cardiac arrest.

Myocardial infarction

- cellular death of cardiac tissue due to anoxia (NO O₂ X)
- also called heart attack.
- Dr Polyoppel (Heart transplant 1994) in India
 - ↑ Beno AIIMS Director 3, August
 - 1st heart transplant by Dr Christian Barnard. (3 December 1967)
(South America)