

= Mesodermal

Blood

= Fluid CT

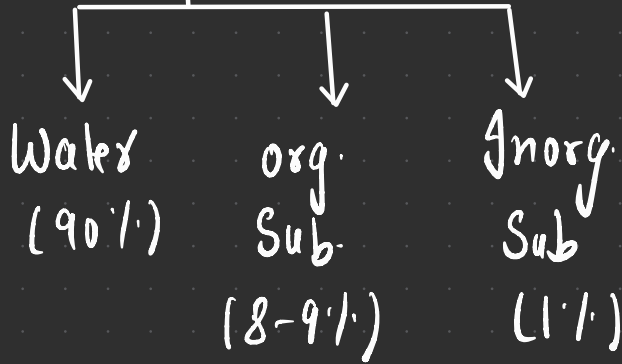
Vol^m of Blood $\begin{cases} \rightarrow \sigma = 5\text{ l} & (8\% \text{ of Body wt}) \\ \rightarrow \text{♀} = 4-4.5\text{ l} & (7\% \text{ " "}) \end{cases}$

ECF = 15 l (Blood form = 33% of ECF)

pH of Blood $\begin{cases} \rightarrow \text{Artery} = 7.4 \\ \rightarrow \text{Vein} = 7.2 \end{cases}$

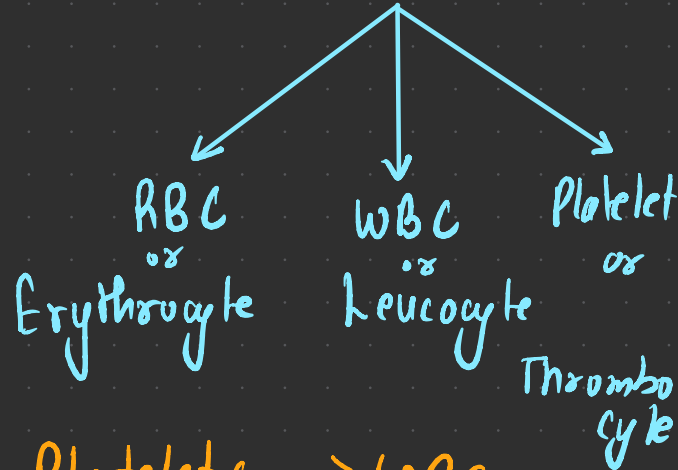
Blood

Plasma (55%)



Formed elements (45%)

→ Blood cells



RBC > Platelets > WBC

Neutrophil > Lymphocyte > Mono > Eosino > Baso

Plasma = Blood - formed elements

Serum = Plasma - Clotting factors

Lymph = Blood - [RBC + Platelets + Macropoeten)

Buffer Sys of Blood $\rightarrow$ Hb & $\text{HCO}_3^- / \text{NaHCO}_2$

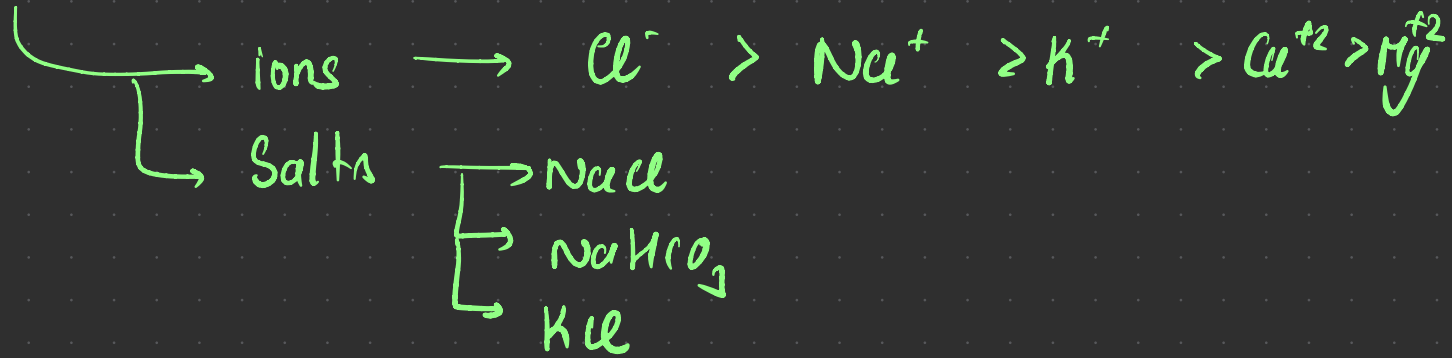
Blood vol^m regulated by JG cells of Kidney $\rightarrow$ Release

Erythropoietin

Erythropoiesis in long Bone $\leftarrow$ (H)

Plasma 55%.

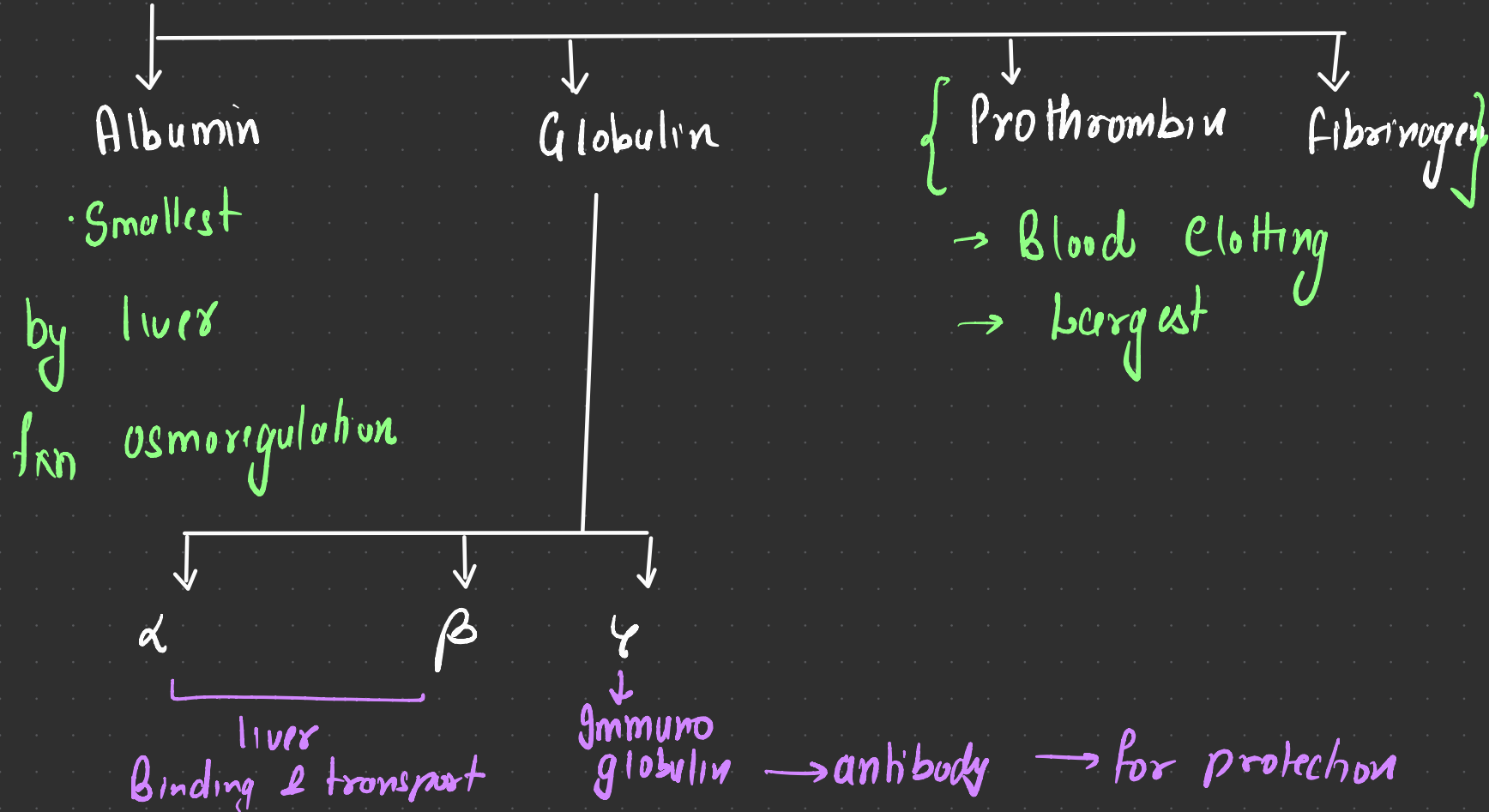
(A) Inorganic subs. (1%.)

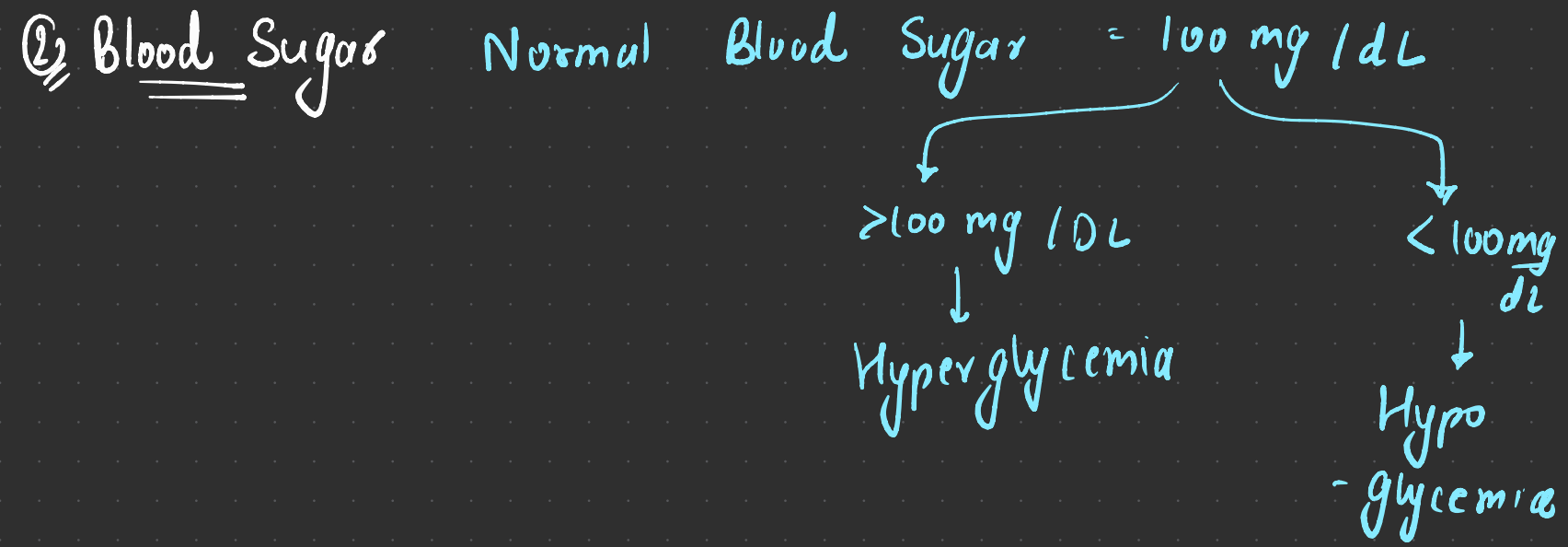


(B) organic (8-9%.)

① Protein (6-8%) Max^m

Protein





③ Blood Cholesterol → 100 - 150 mg/dL

④ Blood Urea → 20 - 40 mg (100 ml) of blood

g/f ↑ Urea
↓
Uremia
← lead to Anaemia

Formed elements

Erythrocyte
or
RBC

life span = 120 days

5.5 million / mm³

Biconcave → ↑ SA

W/o Nucleus & Mito.

→ Motarotⁿ → Vit B₁₂
+ folic acid

Leucocyte
or
WBC

↓
Bone marrow

↓
Leucoblast

↓
Form
WBC

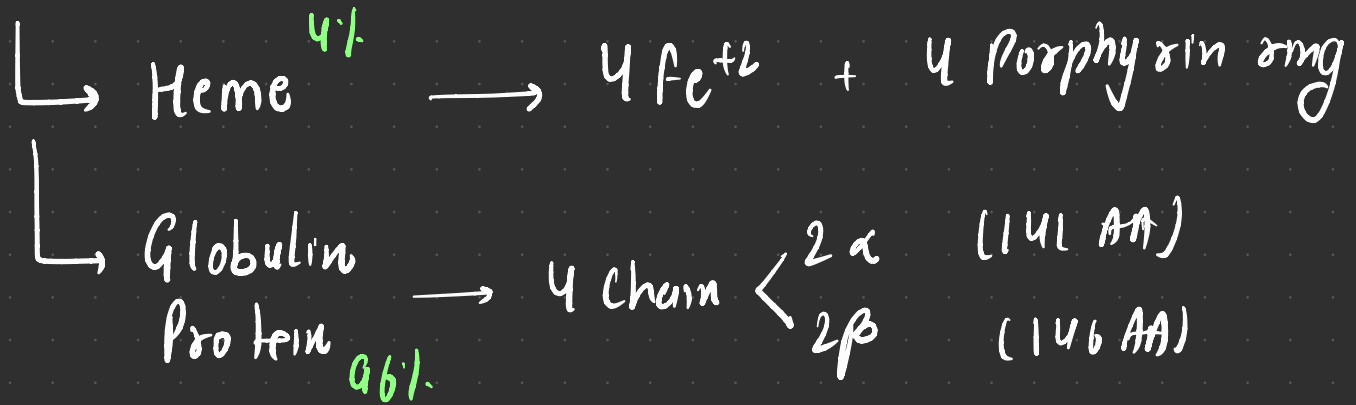
Thrombocyte
or
Platelets

↓
Bone marrow

↓
Megakaryocyte

↓
Form Platelets

Haemoglobin



Spleen - Graveyard of RBC

Erythropoiesis $\begin{cases} \rightarrow \text{Embryo} \rightarrow \text{Yolk sac} \rightarrow \text{Liver} \rightarrow \text{Spleen} \\ \rightarrow \text{Adult} \rightarrow \text{Red Bone marrow} \end{cases}$

Leucocyte

No: $6000 - 8000 / \text{mm}^3$

Ratio RBC: WBC
 $600:1$

Leucocyte $\uparrow$ during infection $\rightarrow$ Leucocytosis

Blood Cancer $\rightarrow$ Leukemia

Diapedesis $\rightarrow$ Amoeboid movement of WBC

Life span $\rightarrow$ hours $\rightarrow$ years

Type of leucocyte

[Agranulocyte]

Cytoplasm w/o granules

Monocyte



largest

phagocytosis (6-8%)

lymphocyte



Smallest

(20-25%)

[Granulocyte]

Cytoplasm with granules

Eosinophil



acidophils

(2-3%)

Basophil



(0.5-1%)

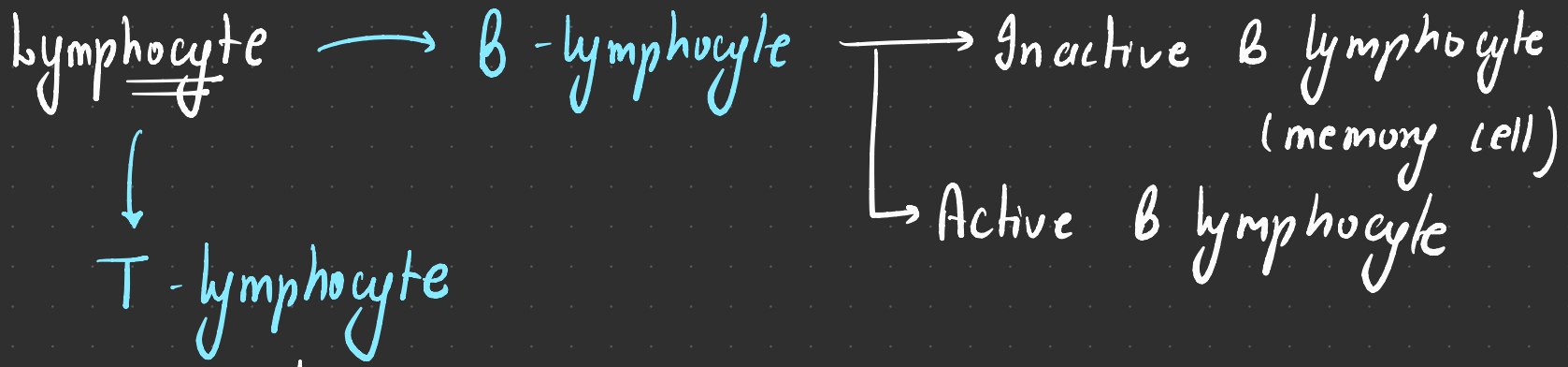
Neutrophil



(60-65%)

phagocytosis

↑
Max^m



Support/help $\rightarrow$ T_R cell

T_S cell

$T_{\text{memory cell}}$

Eosinophil



Anti parasitic granules

or



Contain
cell digestive
enzyme like
lysosome.

Anallergic cell



Contain
antiallergic



Associated with Allergic Rxn

Basophils



Heparin → Anti
coagulant

Serotonin → vaso
constriction

Histamine

↓
Responsible for
inflammation

(Vasodilator)



involve in
inflammatory rxn.

Thrombocyte (Platelets)

No: 1,50,000 - 3,50,000 /mm³

• not in mammals only

Produced by fragmentation of Megakaryocyte cells

• oval shape

w/o nucleus & cytoplasmic organelles

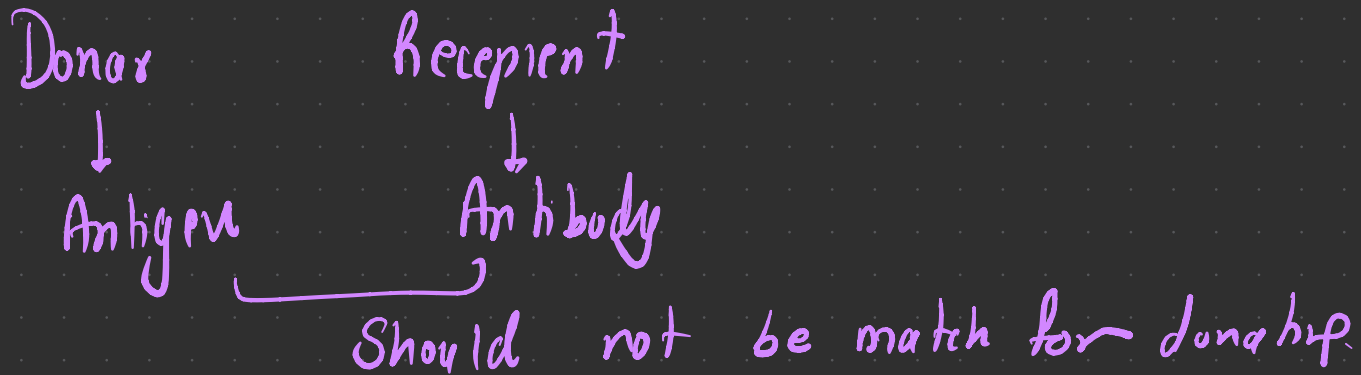
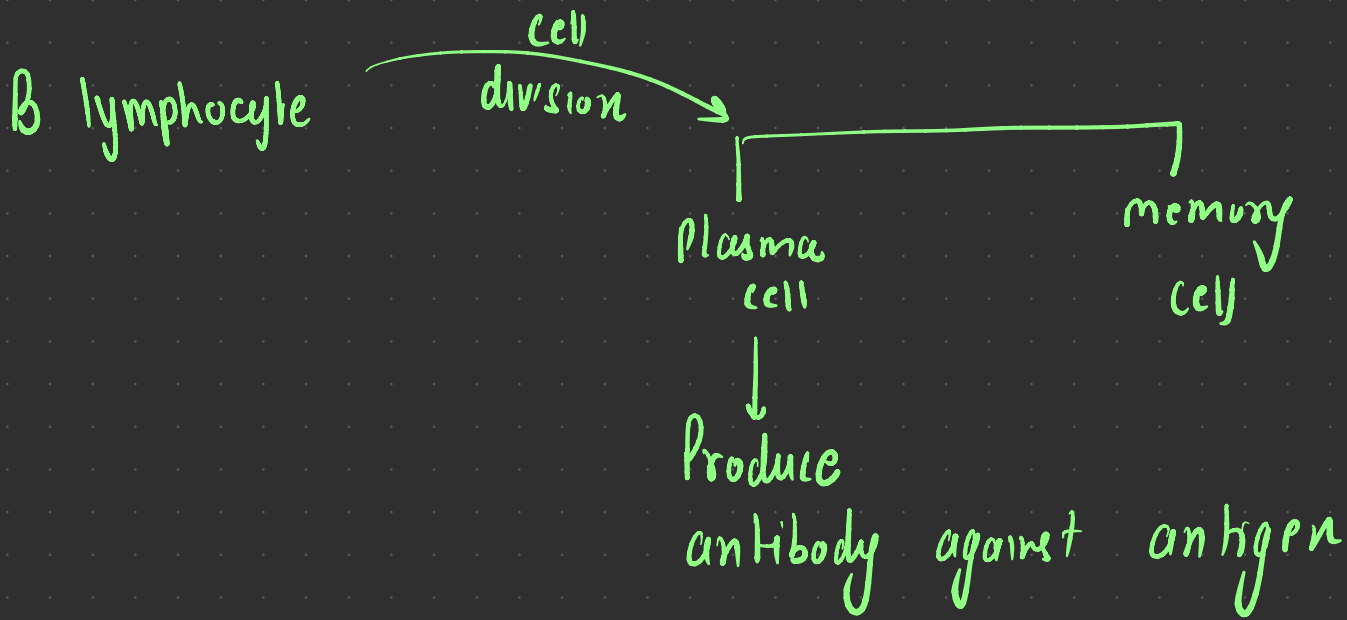
Thromboplastin for Blood clotting → Rxn Help in
life span - 7 days Blood clotting.

Blood group

ABO grouping

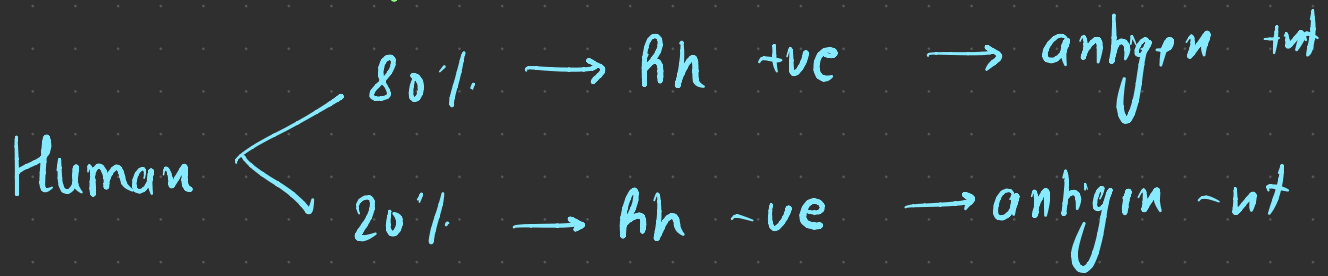
→ +ve/-ve of antigens on RBC $\Rightarrow A \neq B$
→ Similarly, plasma of diff. individual contain 2 natural antibodies

BG	Antigen	Antibody	Donor's grp
A	A	anti B	A, O
B	B	anti A	B, O
AB	A B	x	AB, A, B, O
O	x	anti A, B	O



② Rh grouping

- Rh antigen similar to one +nt in Rhesus monkey
- observed on RBC surface of Majority (80%)



* Rh incompatibility (mismatching)

g | Mother (-ve) } → 1st baby normal
father (+ve) } But other show ↓

Juandice &
Anamia.

due to
erythroblastosis
in foetus.

1st baby

Foetus

Placenta

Mother's
Rh -ve

Rh +ve



Plasma
cell

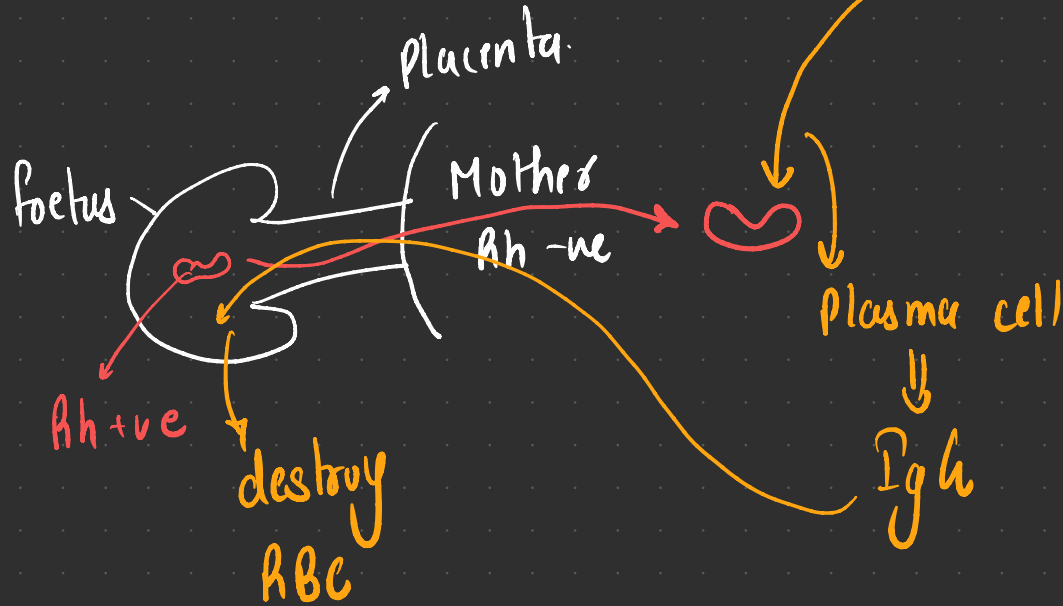
Memory
cell

Anti Rh
antibody

Mainly IgM

IInd baby

Memory cell



Preventⁿ



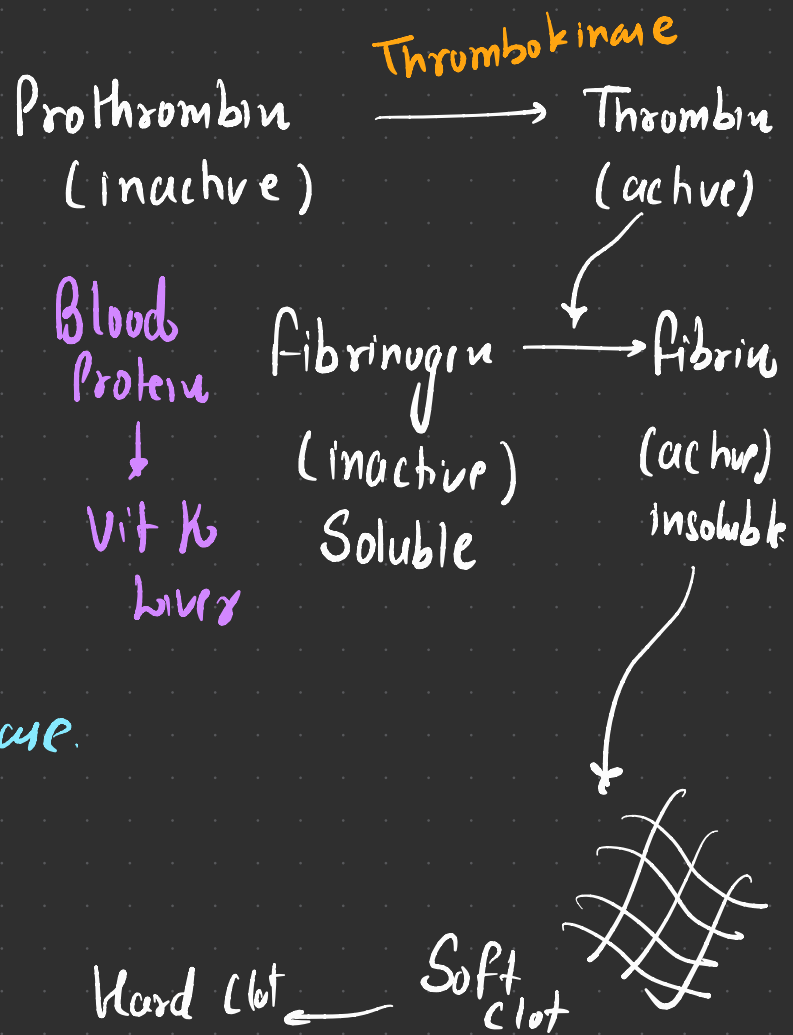
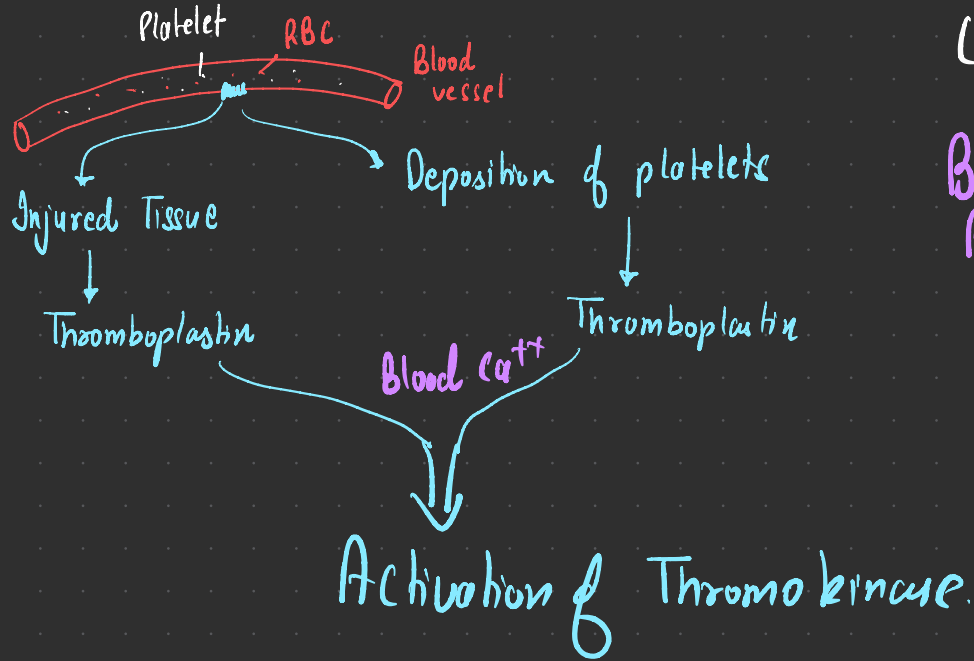
Injection



Anti Rh antibody

(Rhogam)

Coagulation of Blood



→ 13 clotting factors.

→ Ca^{++} plays imp. role

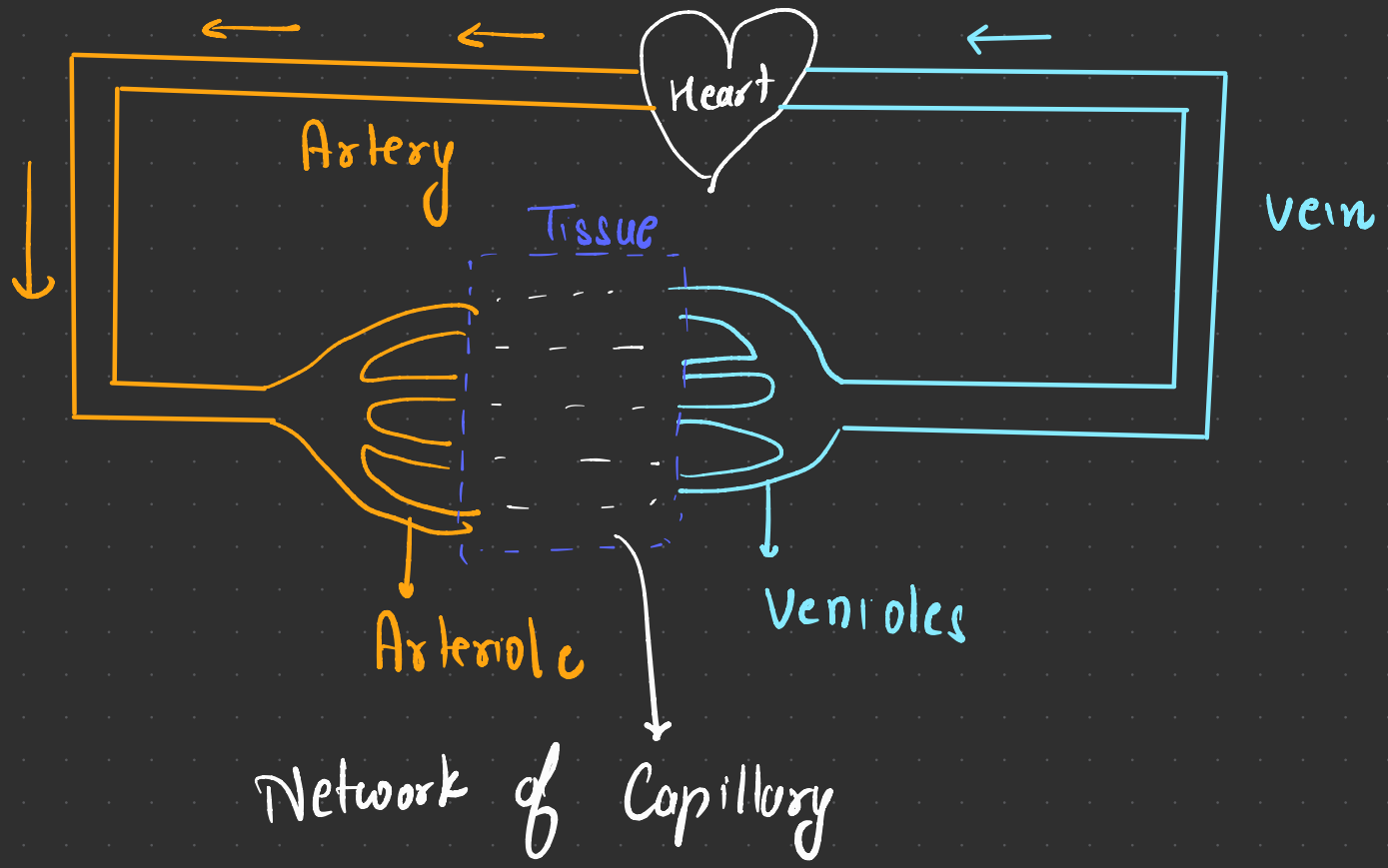
→ Vit K $\longrightarrow$ ^{formation of} clotting factors (2, 7, 9, 10) in Liver.

Some important anti coagulents

1. Heparin → Natural Anti coagulant → in Blood, mast cell, Basophils
→ In → Block prothrombin → Thrombin

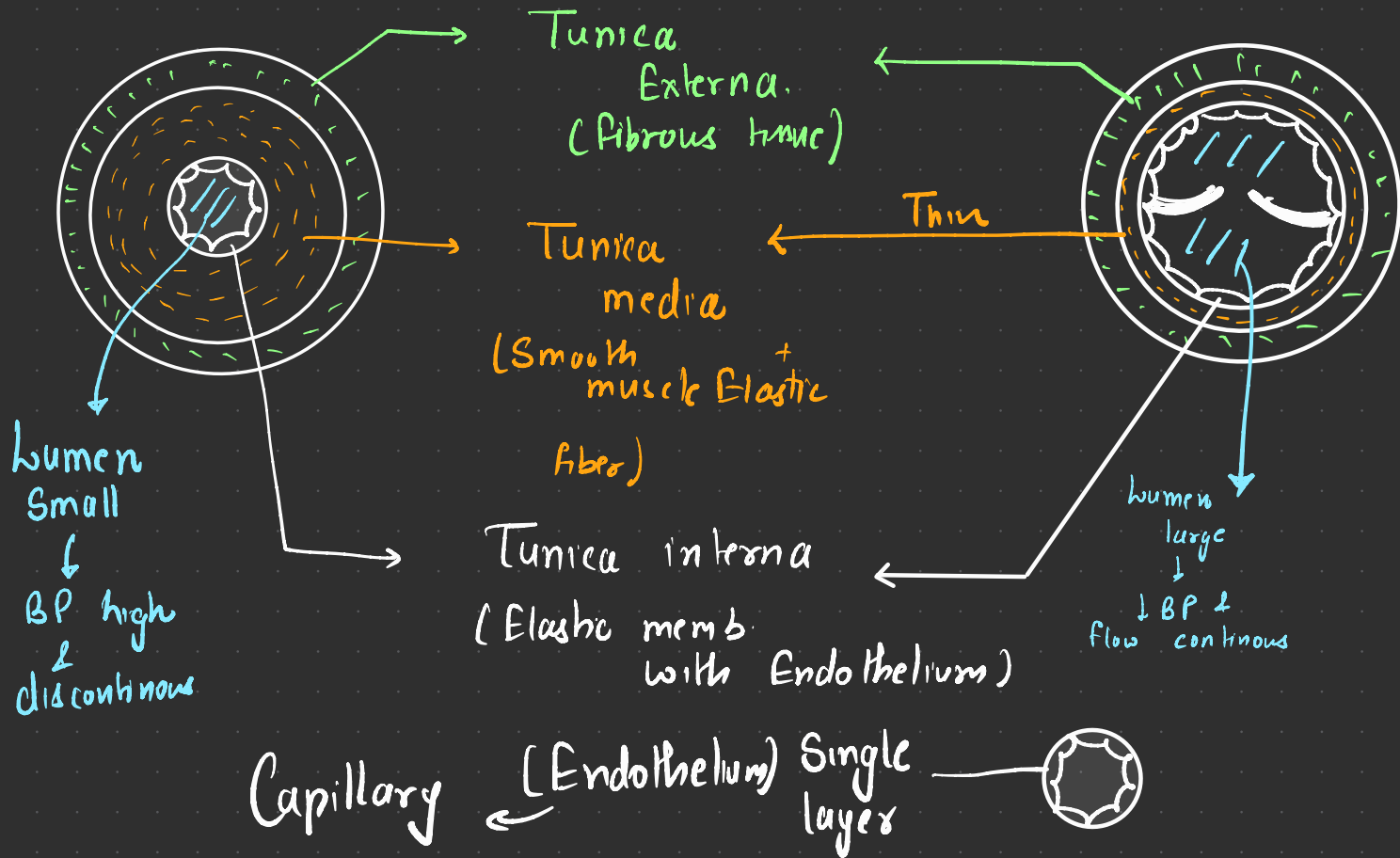
2. EDTA } Ca^{++} Binders.
3. Na & K oxalate }

Blood Vessels



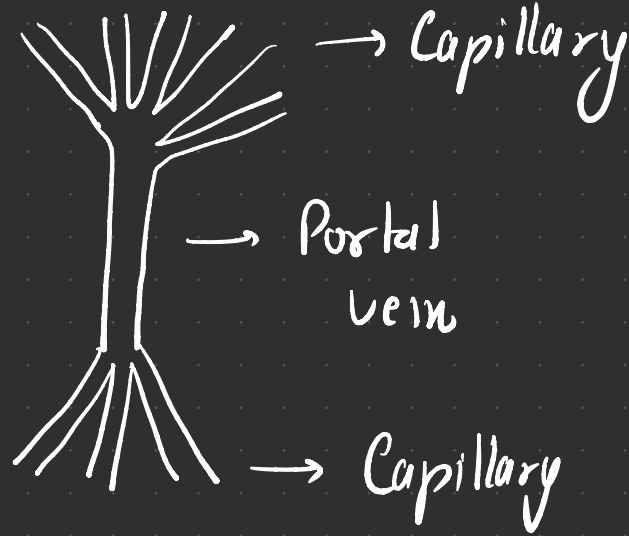
Artery

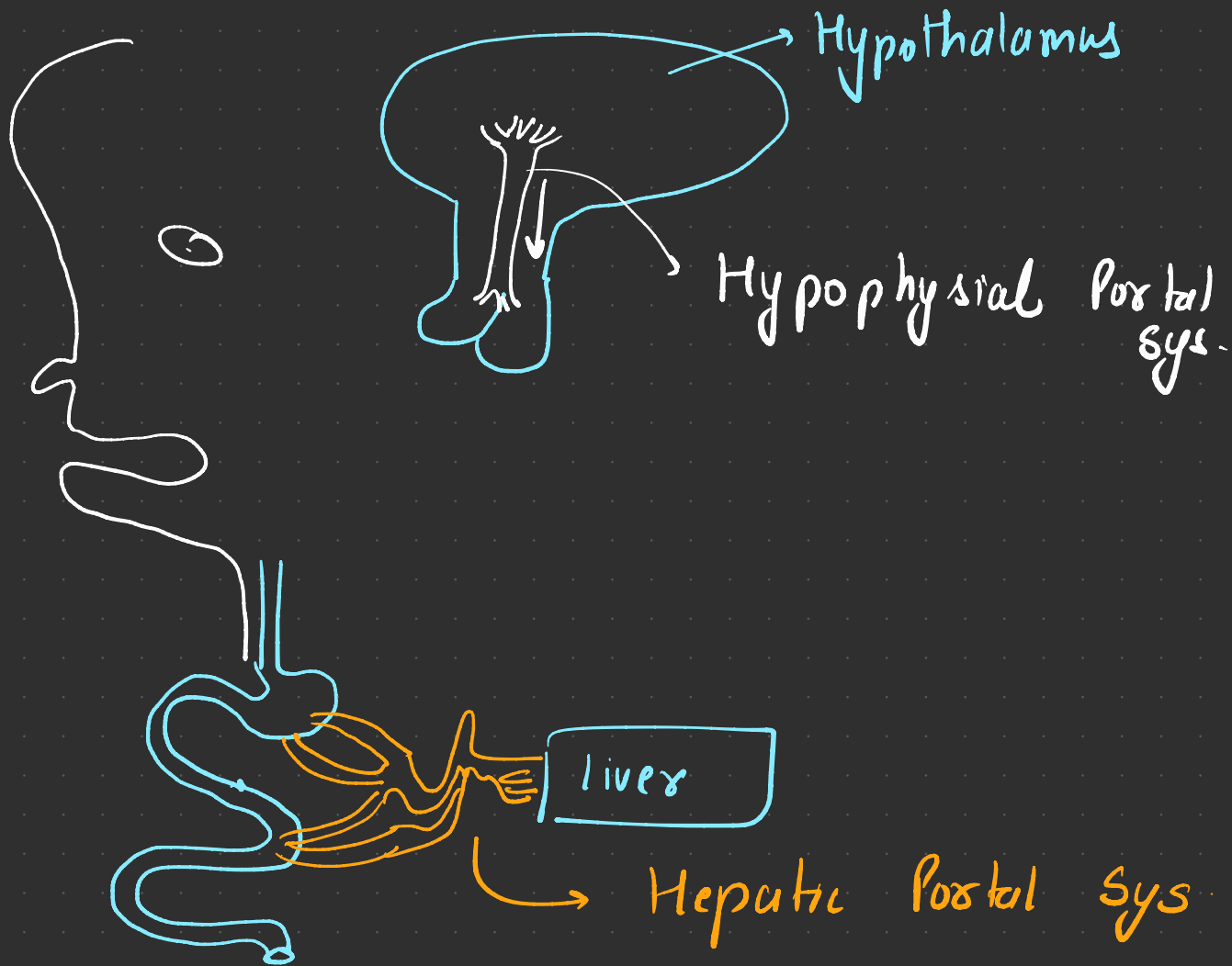
Vein



Portal System

Portal vein





Type of Circulation

Open

→ Haemocoel / Blood sinus



organ / cell Bath
in Blood

Eg

Arthropoda
Mollusca

Close

→ No cavity /
Haemocoel

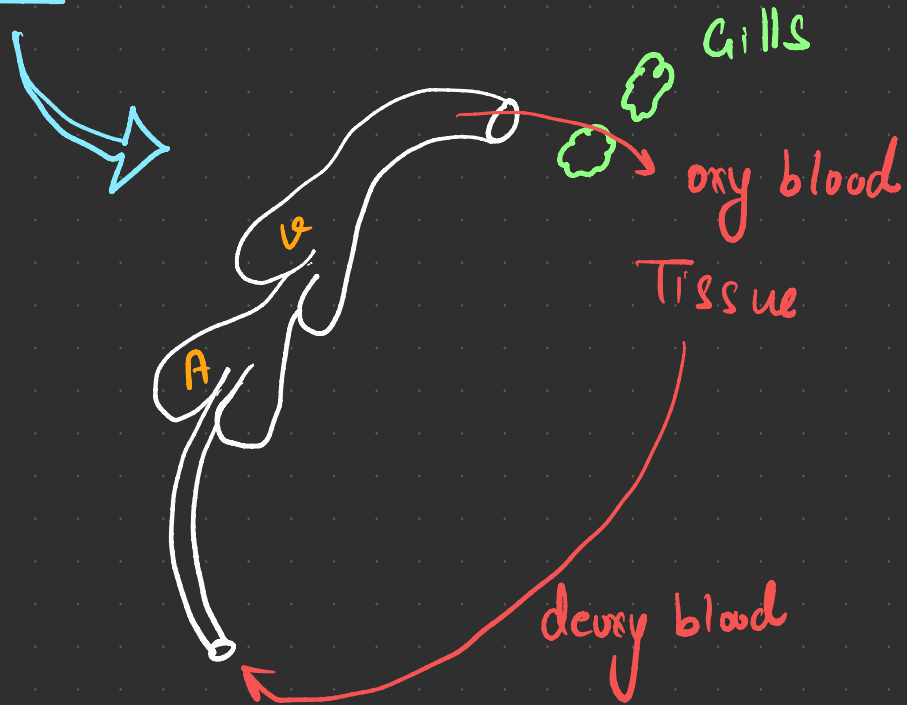
→ well developed
vessels

Eg

Annelida
Chordata

Circulatory pathway

↓ Single & double Circulation



Eg Fish
2 Chambered heart

Systemic Circulation

Ven

①

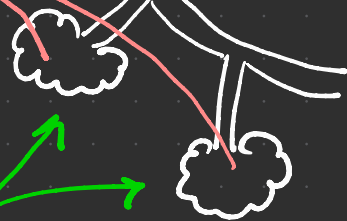


Heart



②
Pulmonary
Circulation

Lungs



Systemic heart



→ Pump only oxy.
blood

→ To tissue

{ LA + LV }

Pulmonary heart

→ Pump only
deoxy. blood

→ to lungs

{ RA + RV }

Chamber involved in

Pulmonary circulation



RV + LA

Systemic circ.

LV + RA

fish (2 Chambered heart) → Single circ

⇓
Amphibians (3 Chambered heart) → double circ

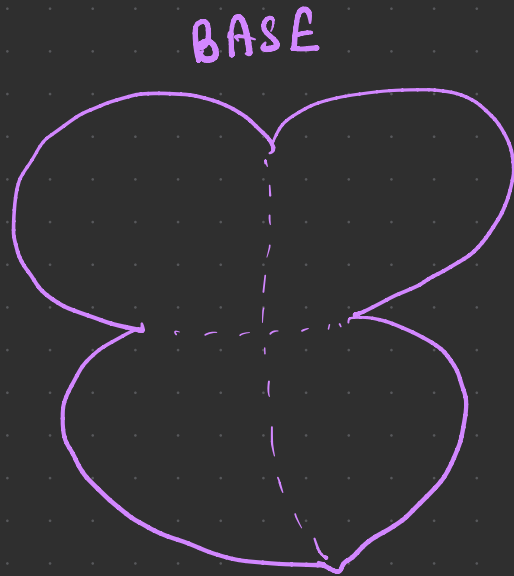
⇓
(2A + 1V)
Mixed blood

⇓
Reptiles (" " ") } incomplete double circulation

⇓
{ Aves +
Mammals } (4 " ")
+ Crocodile

↳ complete double circulation

Structure of Human Heart



BASE

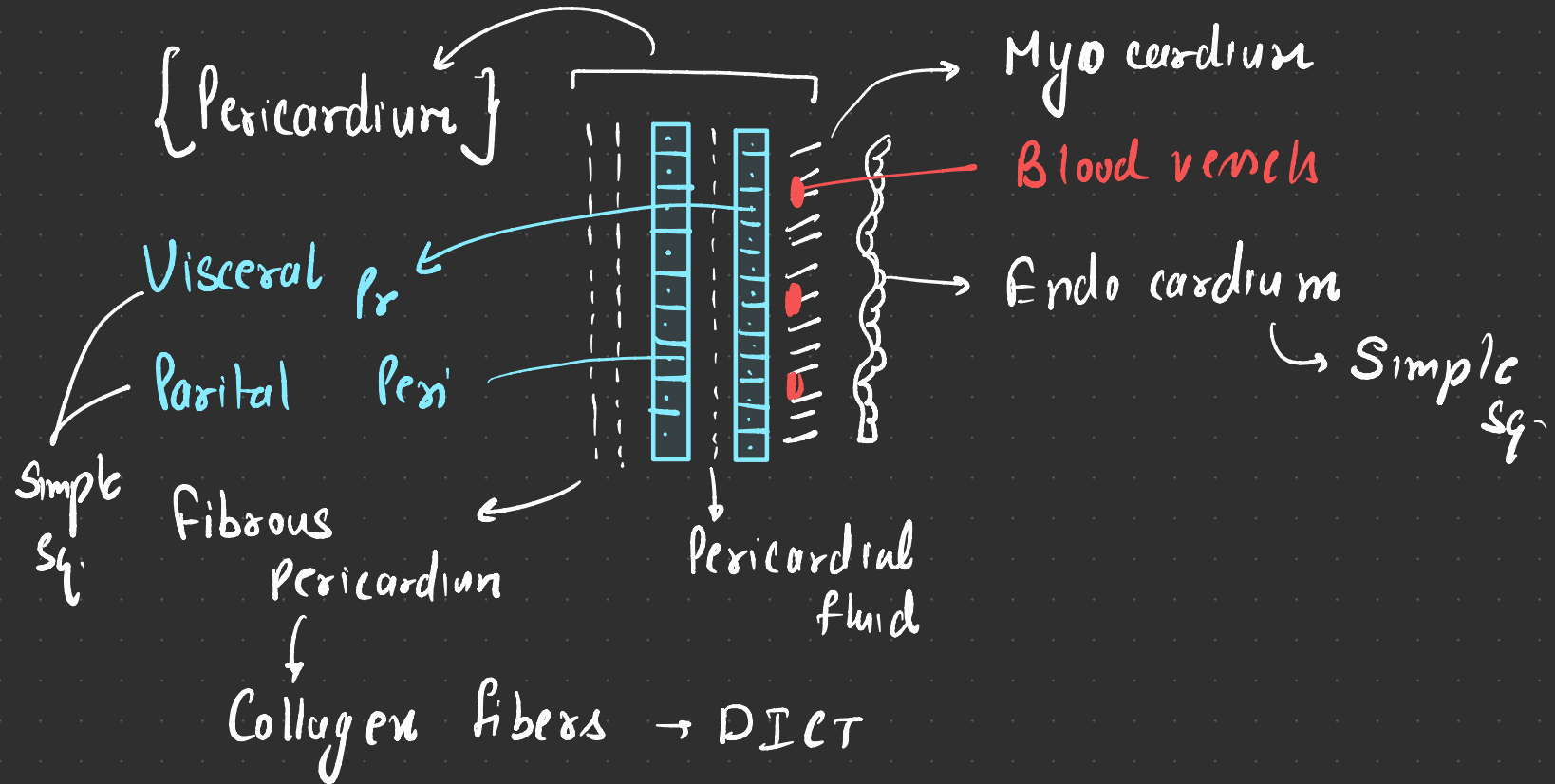
APEX

→ Tilt
towards
left

- origin - Mesodermal
- wt - 250-300 gm
- Position

↓
+nt b/w lungs in
mediastinum near
diaphragm in cardiac
notch

Wall & Covering of Heart



Str

Superior vena cava

Inferior vena cava

SA Node

Bundle of His

Pulmonary vein (2 pair)

RA

LA

RV

LV

Tricuspid valve

Bicuspid valve / Mitral valve

Cordae Tendinae (collagen fiber)

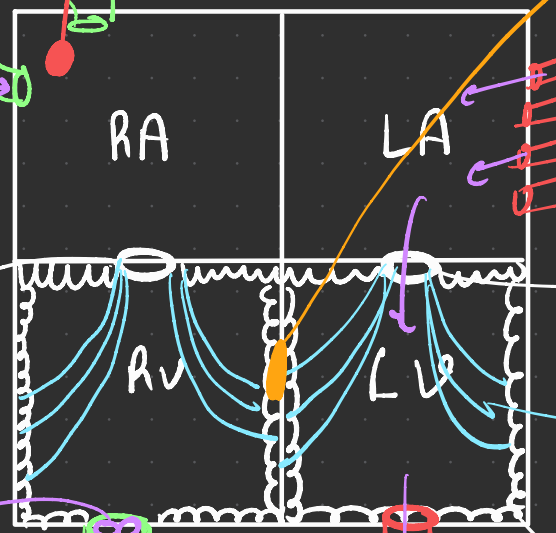
Papillary muscles

LV thick
RV thin
not in ventricles only

Semilunar valve

Pulmonary artery

Aorta (largest artery)



Note

Valve of heart

It is double fold of Endocardium with muscular flap

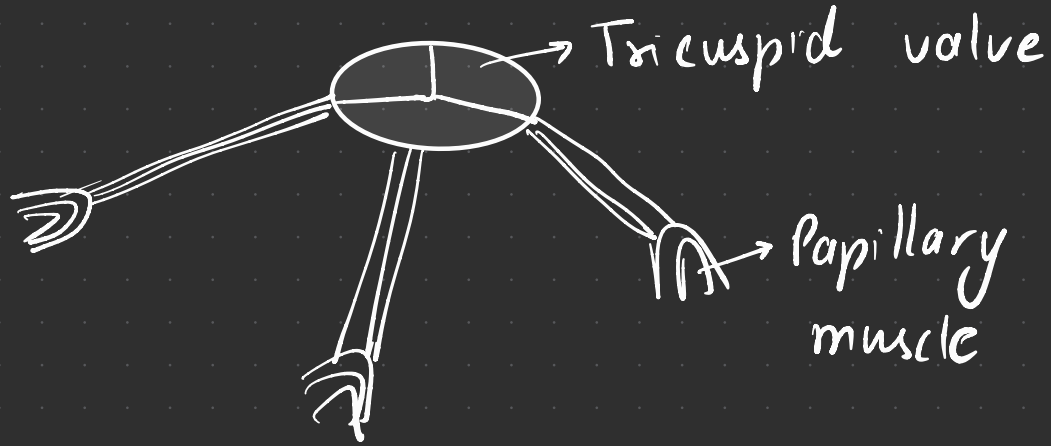
→ Atrio Ventricular / Cuspid valve

↳ Bi & tricuspid valve

→ Ventriculo - Arterial valve

↳ Semi lunar
valve.

Chordae Tendinae → Collagen fibre + int b/w
Cuspid valve & papillary muscle



Keep the flap of valve towards ventricle
during ventricle contraction.

Conduction of Heart beat (Human heart - Myogenic)

↓
originate from Modified Cardiac muscle cells
[Nodal tissue]

→ Show autorhythmicity
(capacity of self
contraction)

Type of Nodal tissue

SA node
(Pacemaker)

Position → upper right
corner of RA

AP → 70-75
impulse/min

AV node
(Pacemaker)

lower left
corner of RA

60-65

Bundle of
His
(AV Bundle)

Intra
ventricular
Septum

40-45

Purkinje
fibre

only in
walls of
ventricle

20-25

Largest Nodal tissue can generate 100 Imp./min

↓
but only 70-75 Imp/min

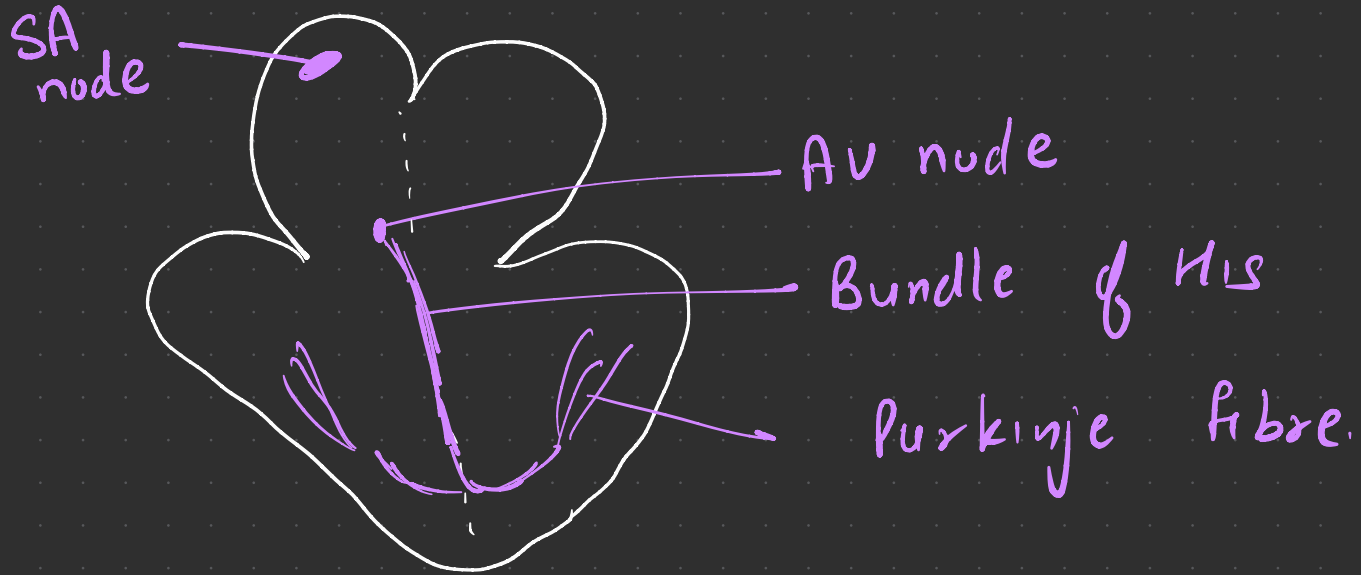
↓
due to Vagus nerve. (inhibitory nerve)

SA node → responsible for rhythmicity of heart

↘
Nonst
functional

→ Heart
arhythmic

→ we
artificial
Pacemaker.



Regulation of Cardiac activity

Regulation
Center

⇒ Medulla Oblongata (CNS)

PNS

→ ANS

Parasymp (Resting)

Symp (Emergency)

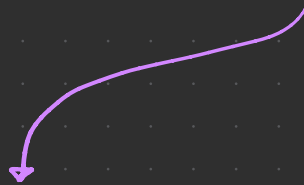
Vagus
nerve

Acetyl
choline

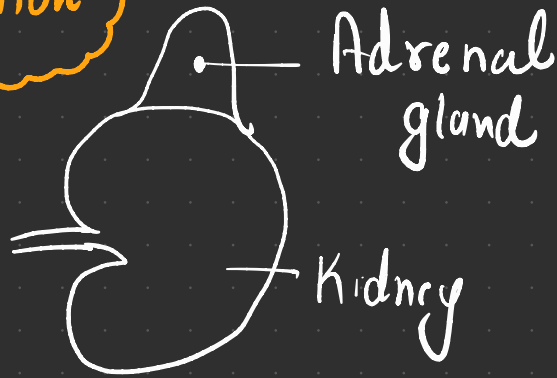
Epi +
NE

↑ Heart
beat

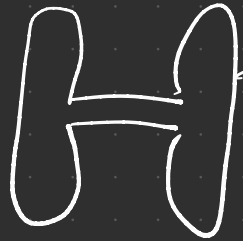
↓ Heart
beat



Hormonal Regulation



Adrenalin
 NA^+ } $\uparrow$ Heart beat



Thyroid gland

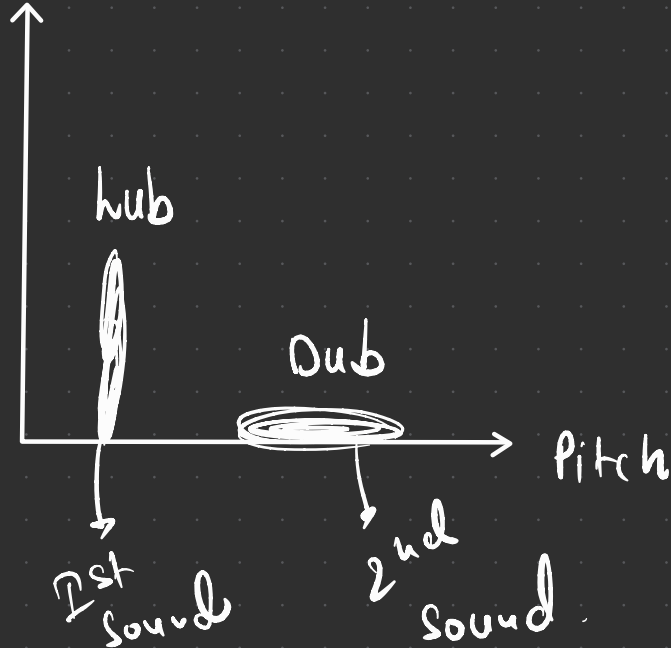
Thyroxine
 $\uparrow$ BMR

Heart beat
 $\uparrow$ in child
 $\downarrow$ in old person

$\uparrow$ Heart beat

Heart Sound

Duration



Lub	dub
due to closure of AV valve	due to closing of Semilunar valve
Ventricular Systolic Sound	Ventricular diastolic sound
low pitch	high pitch
long duration	low duration

Cardiac Cycle

- It is a complete Contractⁿ & Relaxation of (A) & (V)
(Systol) (diastole)
or Cardiac muscle
- Single Cardiac Cycle duration = 0.8 sec.

	Systol	diastole
Atria	0.1 sec	0.7 sec
Ventricle	0.3 sec	0.5 sec

Max. pr. during
Systol of
left ventricle

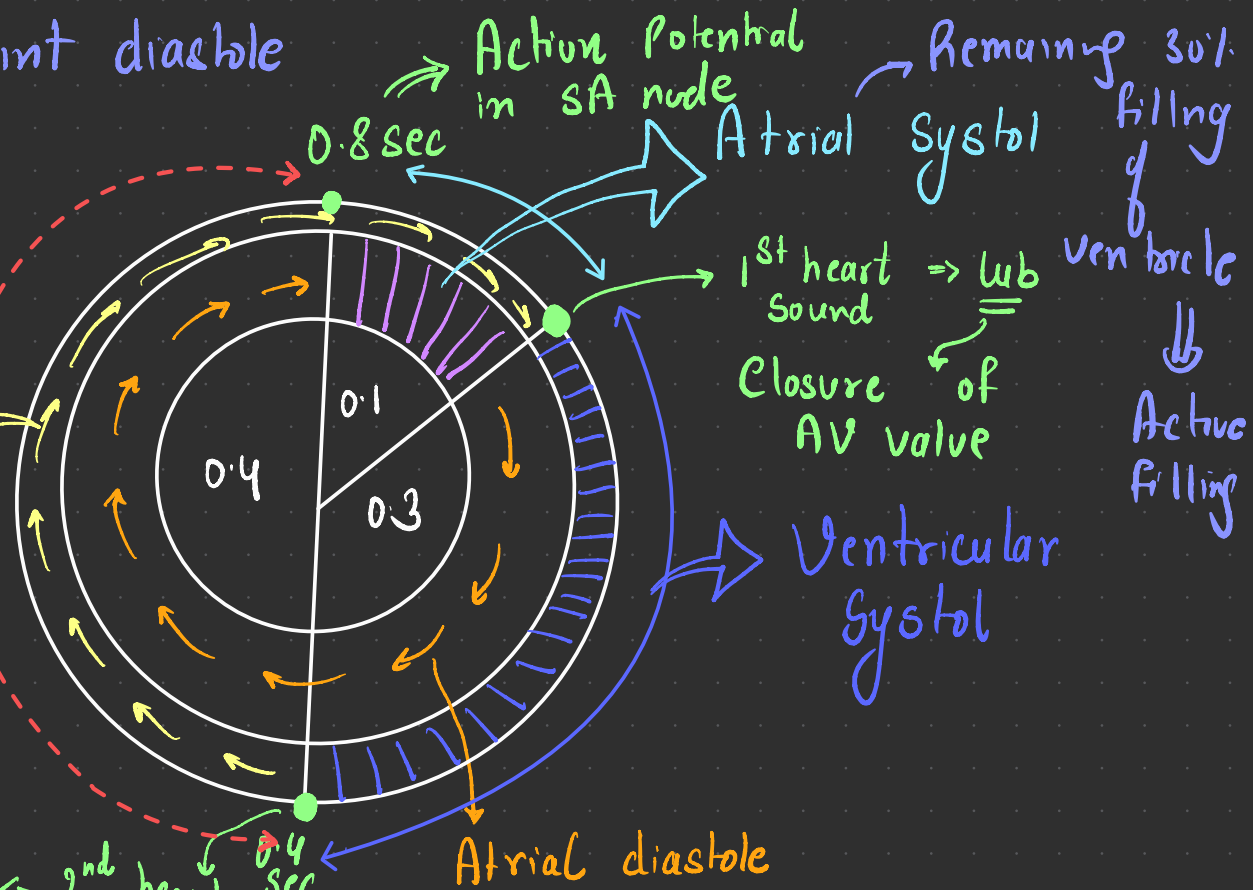
At the end of Joint diastole

↓
70% ventricle filled
↓
Passive filling
(0.4 sec)

Joint diastole

Ventricular diastole

dub ← 2nd heart sound
↓
Closure of Semilunar valve



Action Potential in SA node

Remaining 30% filling of ventricle

Atrial Systol

1st heart sound ⇒ lub
Closure of AV valve

Active filling

Atrial diastole

Ventricular Systol

End diastolic vol^m | 120 ml |

Vol^m of blood, which collect in each ventricle at the end of their diastole.

End Systolic vol^m

Vol^m of blood, which remaining in each ventricle at the end of their Systole. | 50 ml |
fixed.

Stroke vol^m

vol^m of blood, which pump by each ventricle during simple Systol.

$$\begin{aligned} SV &= Edv - ESV \\ &= 120 - 50 = 70ml \end{aligned}$$

Cardiac o/p

vol^m of blood pumped by each ventricle per min

$$\begin{aligned} C_{o/p} &= SV \times HB \\ &= 70ml \times 72 = 5040ml/min \end{aligned}$$

Blood pressure

pressure which exerted on wall of blood vessel during flow of blood.

Measure - Sphygmomanometer

diastolic

||
80 mm Hg

Systolic

||
120 mm Hg

Note Pulse pr = Syc BP - di BP $\rightarrow$ 40 mmHg

High BP $\rightarrow$ $\frac{140}{90}$ (Hypertension) $\rightarrow$ May damage
your brain &
kidney.

low BP $\rightarrow$ $\frac{110}{70}$

Tachycardia $\rightarrow$ $\uparrow$ Heart beat.

Disorder

① Coronary Artery disease (CAD) / Atherosclerosis

• Affect the vessel that supply blood to heart muscle.

• due to deposition of fat, cholesterol, fiber.

↓
Artery

→ Lumen → Narrow ↓

↓ blood flow

↓

Myocardial

Ischemia

CAD



Ischaemia



H. failure



Angina



Myocardial
Infarction



Cardiac
arrest



Heart
Stop

② Heart failure

State of heart in which it is not pumping blood effectively enough.

③ Angina → Angina pectoris

→ acute chest pain due to less supply of O_2

→ can occur in any age.

④ Heart attack (Myocardial Infarction)

Death of part of Cardiac muscle.

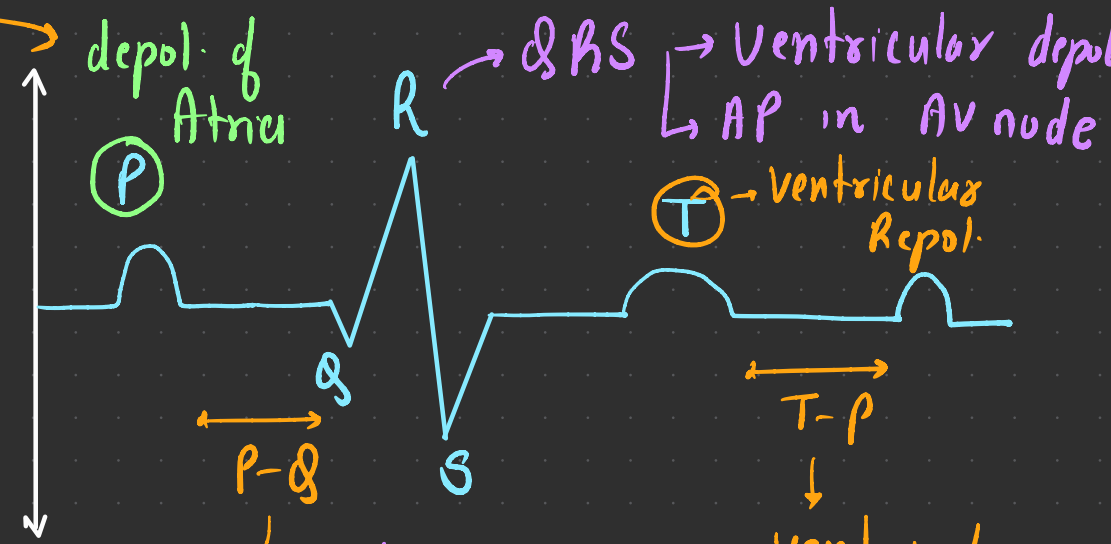
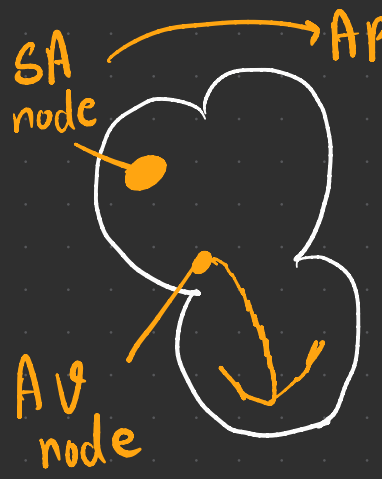
⑤ Cardiac arrest

Death of complete Cardiac muscle.

↓
Cardiac o/p = 0

ECG Electro Cardio graph

- Graphical representation of electrical activity of heart during a cardiac cycle
- Standard ECG → 3 electro lead
that continuously monitor heart activity
 - one into each wrist
 - left ankle



P-Q
 ↓
 Contractⁿ of Atriu
 +
 Gen. of AP in SA node

Q-T
 ↓
 Gen. of AP in AV node
 +
 Contraction in ventricle

T-P
 ↓
 Ventricular diastole

deviation of shape indicate a possible abnormality



Great Clinical Significance!

↑ R wave & S-T interval ↑ ⇒ Myocardial infarction.

ST interval ↓ or T wave flat?

Myocardial Ischaemia.