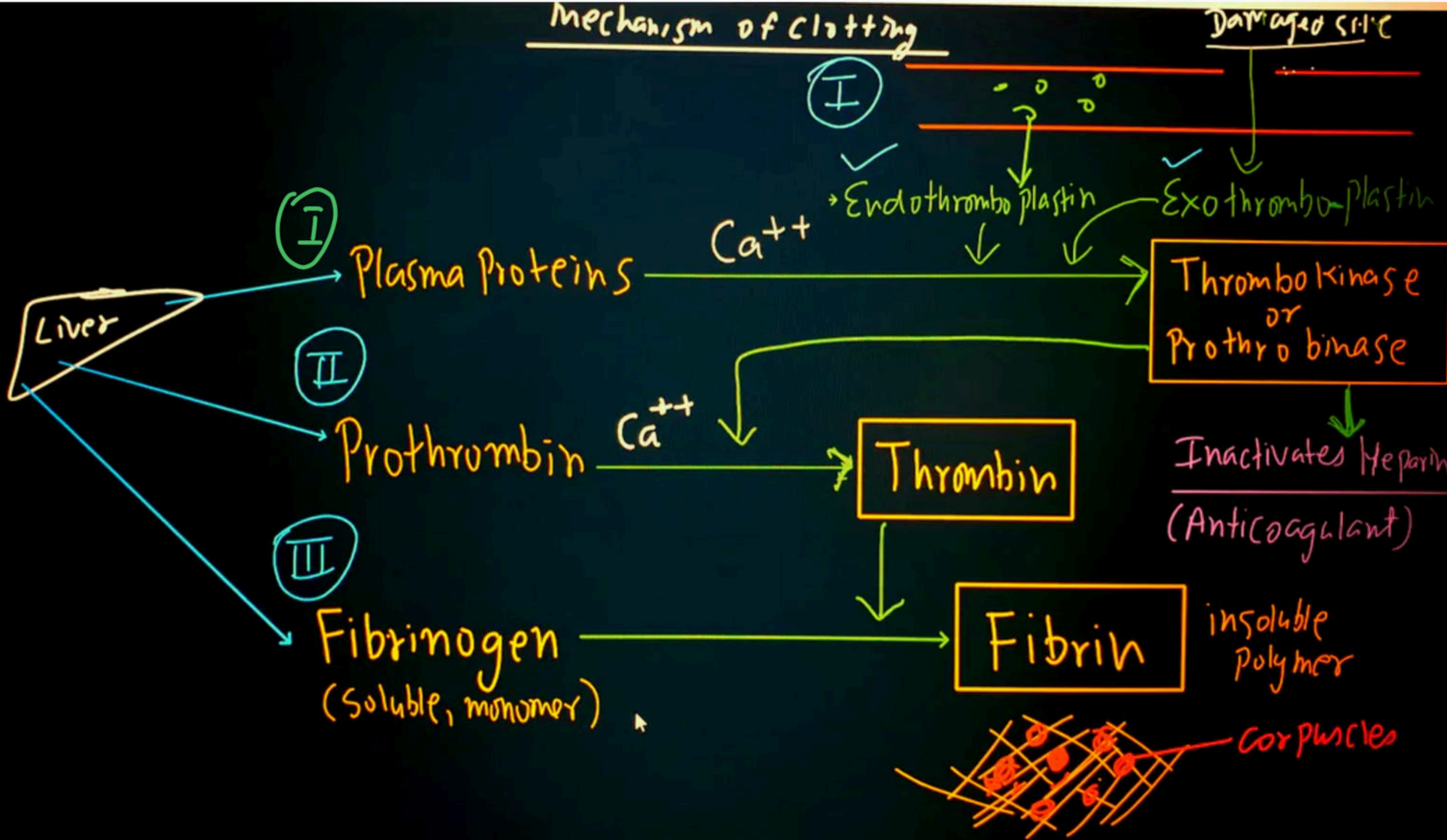




# Doubt Clearing Session

Course on Human Physiology: Body Fluids & Circulation

# Mechanism of clotting





## **BLOOD CLOTTING**

- Blood flow cut or wound but after some times it stops automatically, it is called clotting of blood.
- Bleeding time 1-3 min.  
Clotting time 2-8 min.

Some times clots are also formed in intact blood vessels which are of two types.

### **Thrombus Clot**

1. Static clots which grow bigger & bigger & ultimately block the blood vessels.
2. If this clot is formed in the coronary vessels then called as coronary thrombosis which can cause heart attack.
3. If found in brain, then called as cephalic thrombus causes paralysis.

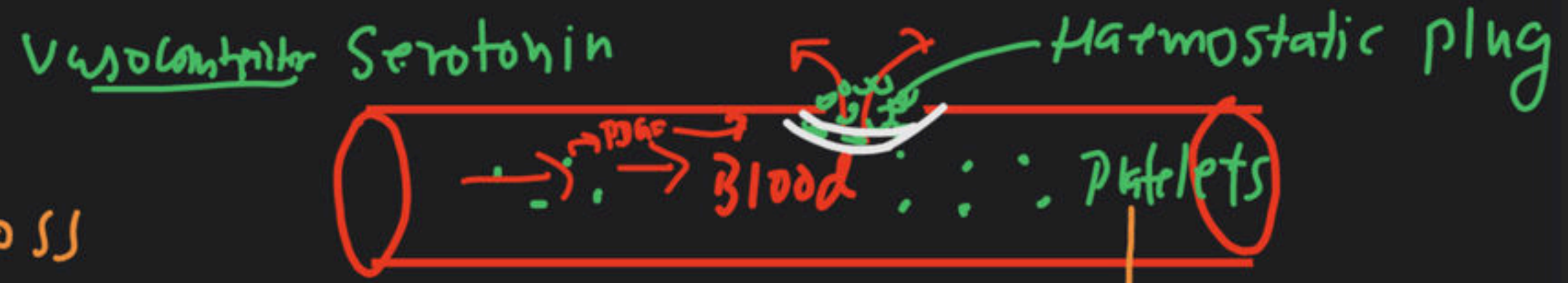
### **Embolus clot**

1. Moving clots which flow with blood.
2. More harmful due to their moving nature.



Vasoconstriction (Proximal to the site of injury)

Haemostatic Plug → To Reduce Blood Loss



Injured tissue →  
Exothromboplastin      Endothromboplastin

Liver

Plasma Proteins

Prothrombin

Fibrinogen

Soluble, Monomer

$Ca^{++}$

$Ca^{++}$

Thrombokinase  
or  
Prothrombinase

Thrombin

→ Inactivation  
of Antiregulator  
Heparin  
(X)

Fibrin

Insoluble, Polymer



Serum

finally → PDGF causes Regeneration of wall of vessel



## Mechanism of blood clotting

### (Enzyme Cascade theory)

- Proposed by **Macfarlane & Co-Workers**.
- According to this theory there are 3 steps in blood clotting.

#### 1. Releasing of Thromboplastin :-

- Injured tissue synthesis exothromboplastin and platelets synthesis endothromboplastin.
- Both these thromboplastin react with plasma proteins in the presence of  $\text{Ca}^{++}$  ions to form **Prothrombinase enzymes**. (Thrombokinase)
- This enzyme inactivate heparin. (Antiheparin)

#### 2. Conversion of Prothrombin into Thrombin

- Prothrombinase enzyme convert inactive prothrombin into active thrombin in the presence of  $\text{Ca}^{++}$  ion.

#### 3. Conversion of fibrinogen into fibrin

- Fibrinogen is soluble protein of plasma. Thrombin protein polymerise monomers of fibrinogen to form insoluble fibrous protein fibrin.
- Fibrin fibres form network on cut or wound in which blood corpuscles got trapped. This form clotting of blood.
- After clotting a pale liquid oozes from clot called **Serum**. In which antibodies are found.



1 2 3 4 5 7 8  
**Fresher's Party Tonite Come Lets Sing And**  
 9  
**Call Seniors Please Have Fun**  
 10 11 12 F

- 1 ■ **F – Fibrinogen**
- 2 ■ **P – Prothrombin**
- 3 ■ **T – Tissue factor**
- 4 ■ **C – Calcium**
- 5 ■ **L – Labile factor**
- 7 ■ **S – Stable factor**
- 8 ■ **A – Anti-hemophilic factor**

- 9 ■ **C – Christmas factor**
- 10 ■ **S – Stuart prower factor**
- 11 ■ **P – Plasma thromboplastin**
- 12 ■ **H – Hageman factor**
- 13 ■ **F – Fibrin stabilizing factor**

■ **Note – 6<sup>th</sup> factor not known**

Foolish  
 People  
 Try  
 Climbing  
 Long  
 Slopes  
 After  
 Christmas  
 Some  
 people  
 have  
 fallen

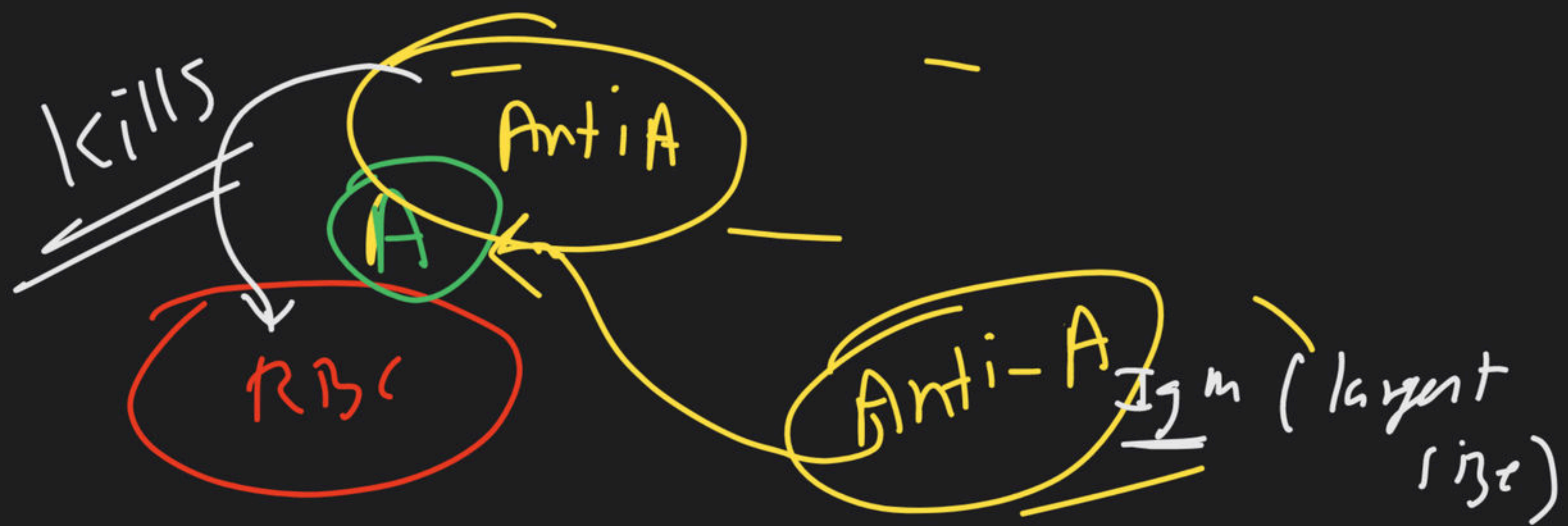


## Clotting factors :-

1. 13 factors help in blood clotting
2. These factors are mainly produced in liver.
3. Vitamin K is required in the synthesis of these clotting factors.
4. These factors are represented in Roman number.

I	—	Fibrinogen
II	—	Prothrombin
III	—	Thromboplastin
IV	—	$\text{Ca}^{+2}$ (cofactor in each step of blood clotting)
V	—	✓ Proaccelerin <i>Labile</i>
<u>VI</u>	—	Accelerin ( <del>Rehected</del> )
VII	—	✓ Proconvertein <i>Stable</i>
VIII	—	AHG (Anti Haemophilic Globulin) (Absent in haemophilic-A)
IX	—	Christmas factor/plasma thromboplastin co-factor
X	—	Stuart factor
XI	—	PTA (Plasma thromboplastin anticedent)
XII	—	Hagman factor (become active by friction)
XIII	—	FSF factor (Fibrin stabilising factor) (Laki lowand factor).

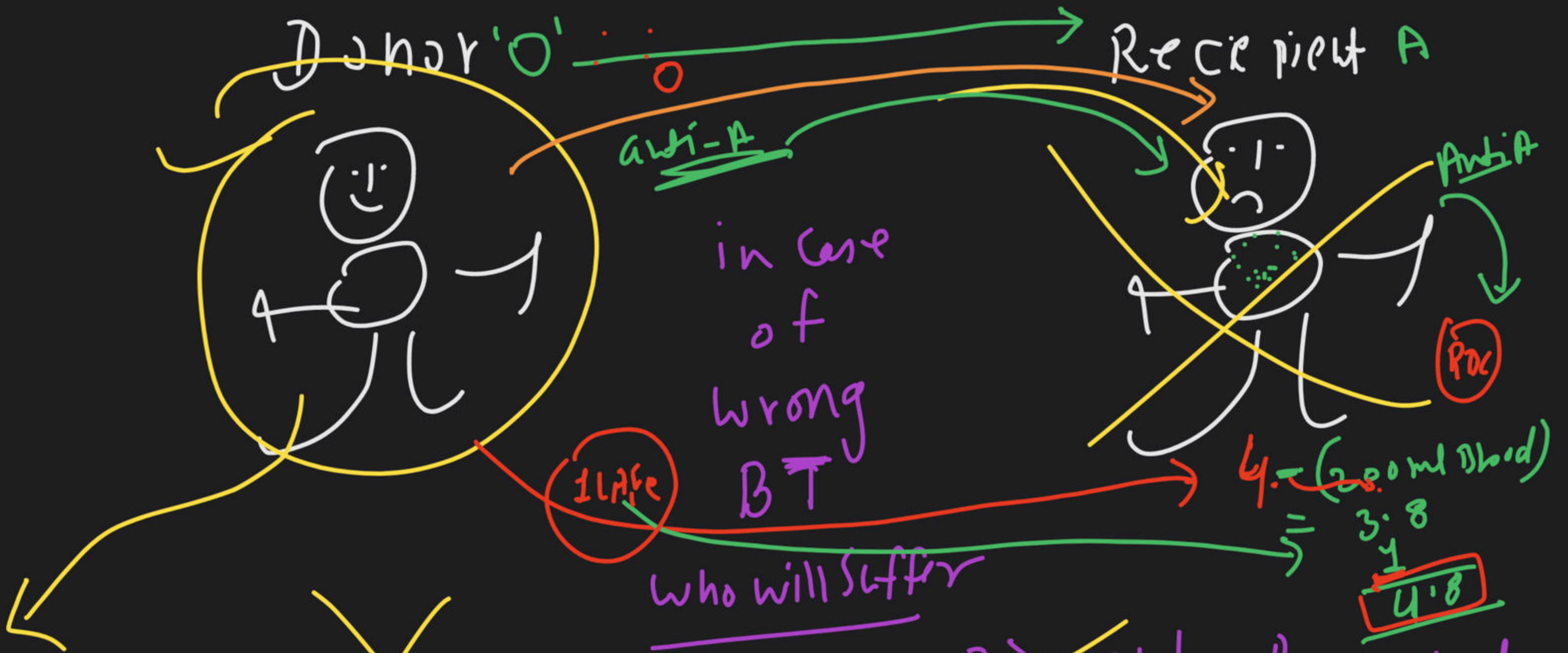
GAMÉD



IgM

Agglutination



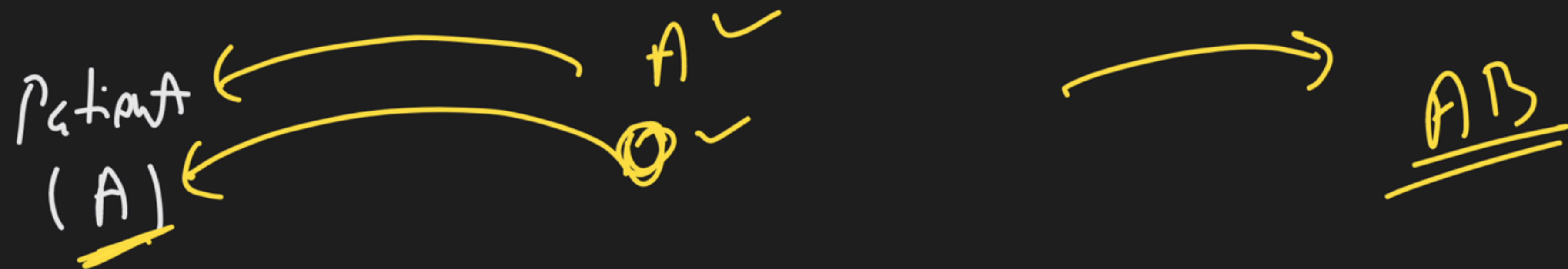


~~A) only Donor~~

~~B) only Recipient~~

~~C) Both~~







Patient  
'A' ← I) A  
II) O

Pre time  
(A) A ✓ } (A)  
(B) B ✓ }

patient  
B ← I) B  
II) O

(G) AB ✓ } (B)  
(D) O ✓ }

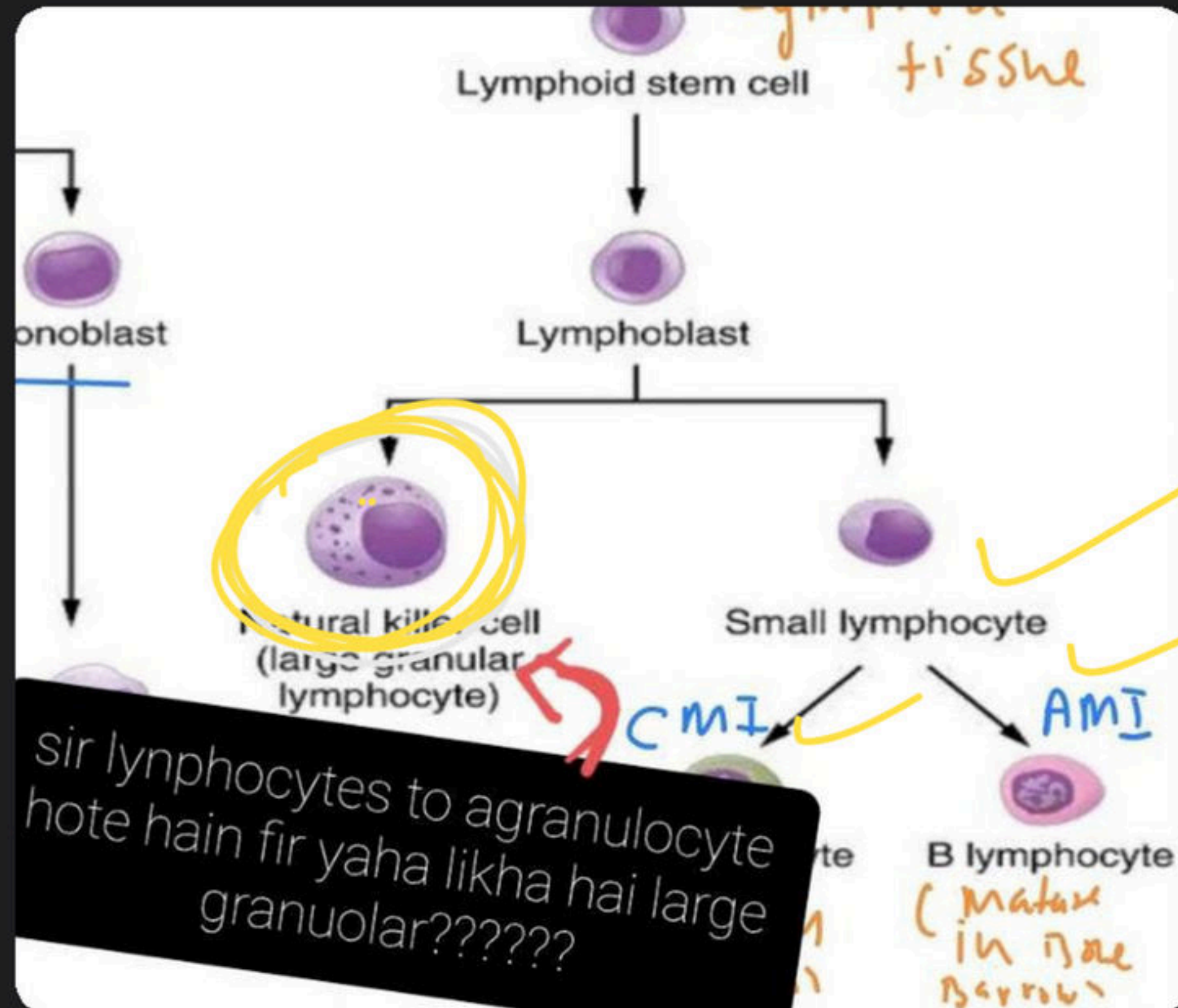
patient  
AB ← I) AB  
II) A or B  
III) O

patient  
'O' ← I) O  
II) X



▲ 34 • Asked by Sakshidube...

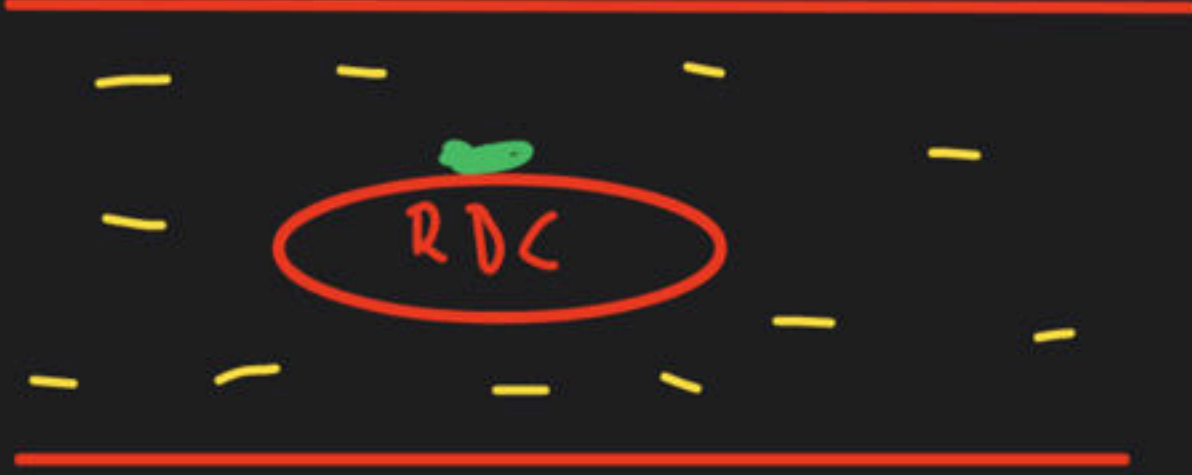
Please help me with this doubt



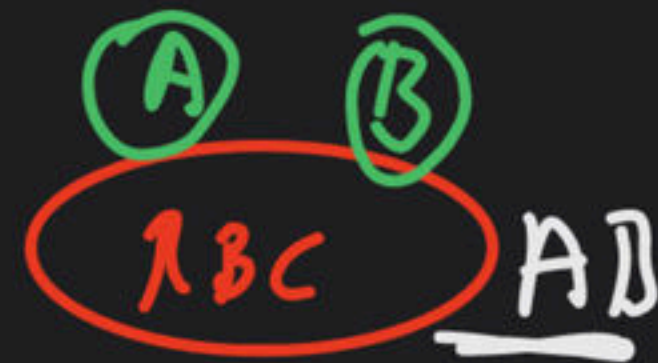
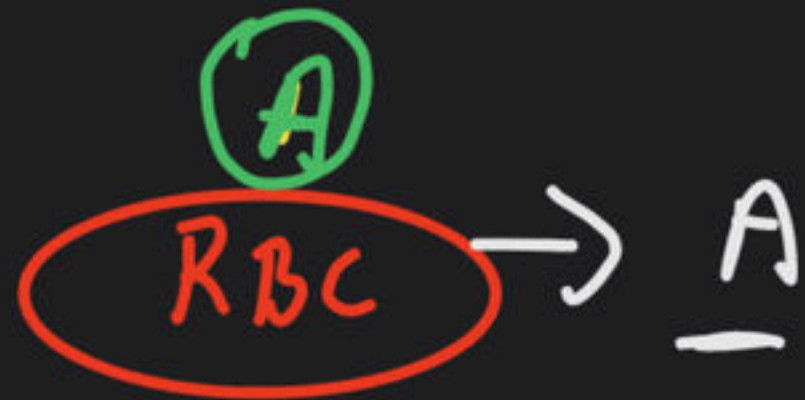


# Blood Groups

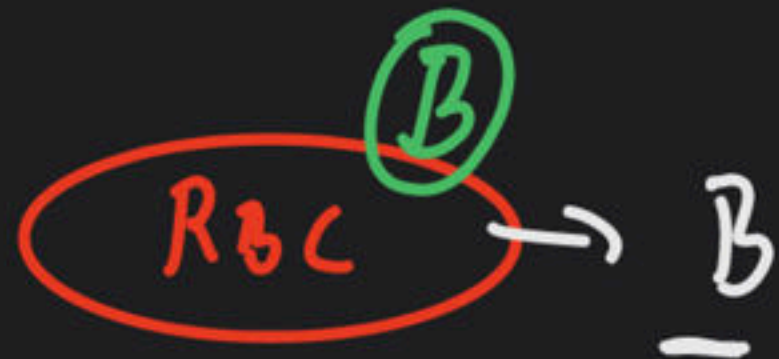
[ABO] system



Antigen (are found over the surface of RBC)  
Give the RBC its identification / Group



These Antigen are of  
(2 Types)





	Group	Antigen (+)	Antibody (+)	Can Receive from	Can Donate to	
<div>(A)</div> <div>RBC.</div> <div>INDIA</div>	A	A	<div>(IgM)</div> <div>anti-B</div>	<div>A</div> <div>O</div>	<div>A</div> <div>AB</div>	
<div>(B)</div> <div>RBC</div> <div>PAK</div>	B	B	anti-A	<div>B</div> <div>O</div>	<div>B</div> <div>AB</div>	
<div>(A) (B)</div> <div>RBC</div> <div>JK</div>	AB	A & B	none	<div>A</div> <div>B</div> <div>AB</div> <div>O</div> <div>(All)</div>	AB	Universal Recipient
<div>RBC</div> <div>America</div>	O	none	<div>anti-A</div> <div>anti-B</div>	O	<div>A</div> <div>B</div> <div>AB</div> <div>O</div> <div>(All)</div>	Universal Donor



Donor

anti(B)

will it not kill

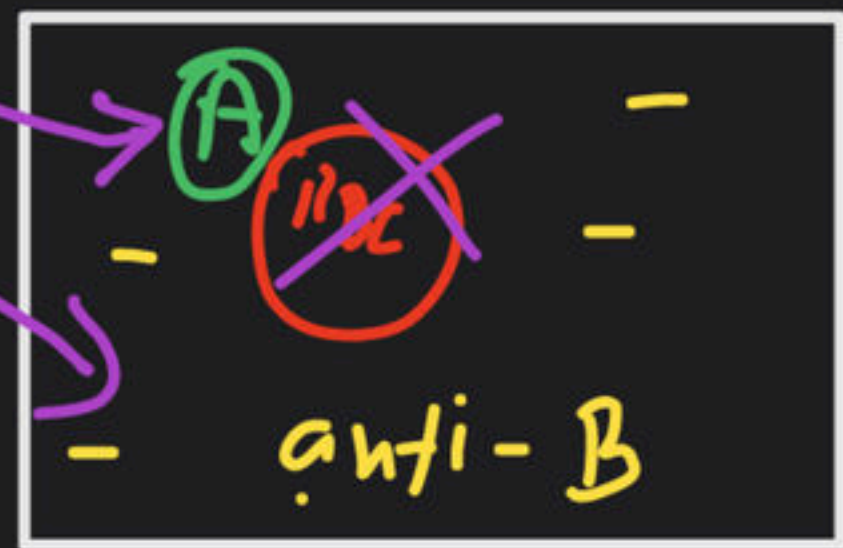
Recipient



will it not kill

'O' (anti-A)

'A'





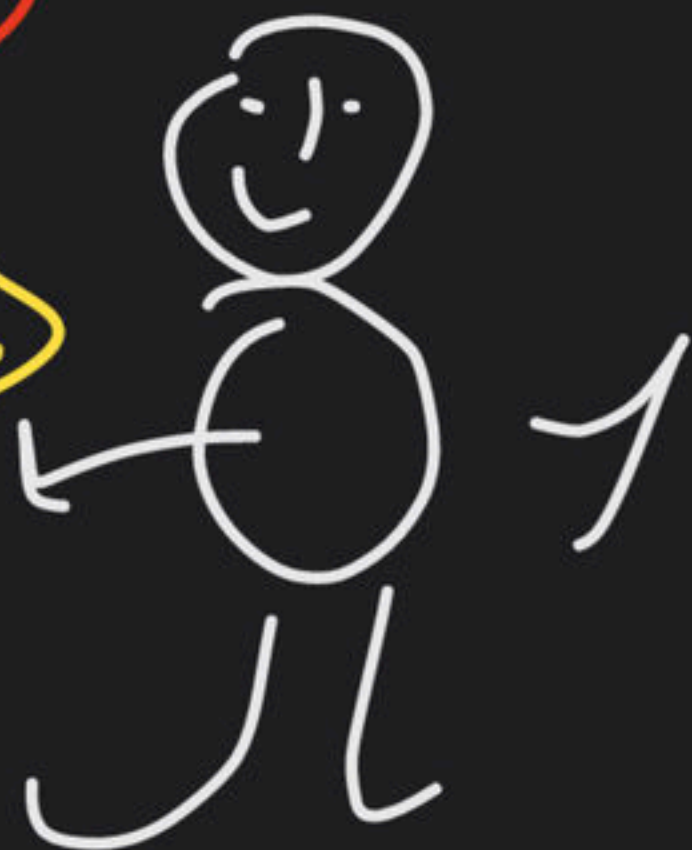
~~A~~ B



anti-A  
anti-B

~~A~~ B

A B



Donor

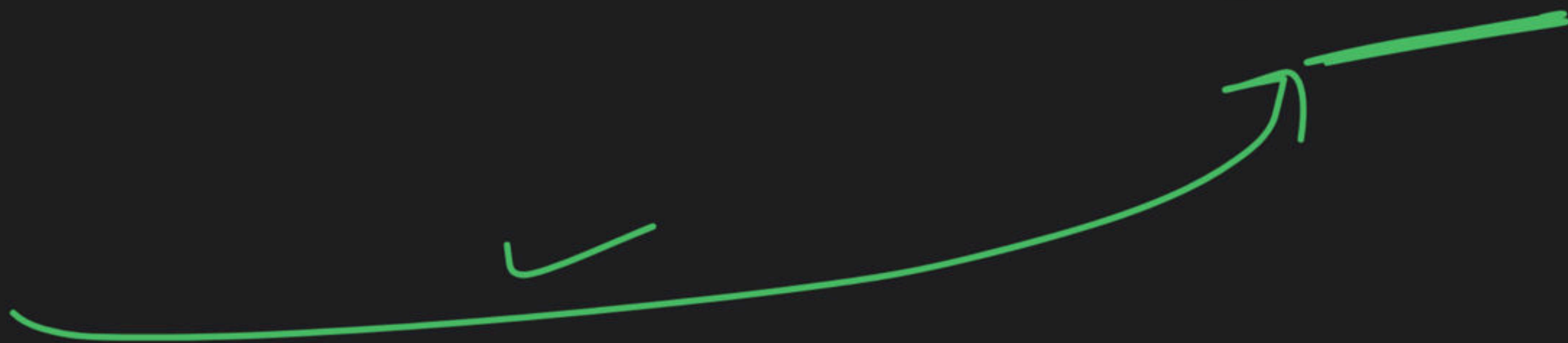
X O -

X A -

X B -

A B

Recipient



## Blood Groups

- Antigen of blood groups is present in the surface of RBC also called as **agglutinogen**.
- Antibody for blood group antigen is present in serum (plasma) called **agglutinin**.
- Blood grouping Antigen & Antibody are special type of glycoproteins.
- Blood groups are of 4 type A,B, AB, O.
- A, B, O discovered by Landsteiner. (Father of blood grouping)

Blood Group	Antigens on RBCs	Antibodies in Plasma	Donor's Group
A	A	anti-B	A, O
B	B	anti-A	B, O
AB	A, B	nil	AB, A, B, O
O	nil	anti-A, B	O

- Blood group O is **universal donar** & Blood group is AB is **universal acceptor**.



## RH FACTOR

- Discoverd by **Landsteiner & weiner** in Rhesus monkey.
- Rh antigen is due to dominant gene. So if one of the gamete possess gene of Rh factor, its off Spring will be Rh + Ve.
- If antigen is present then Rh<sup>+</sup>.
- If antigen is absent then Rh<sup>-</sup>.

**In India % ratio of Rh is –**

Rh<sup>+</sup> – 97%

Rh<sup>-</sup> – 3%

**In World –**

- Rh<sup>+</sup> – 80%
- Rh<sup>-</sup> – 20%
- In Rh<sup>+</sup> antibody is absent for this antigen.
- Rh antibody is also absent in Rh<sup>-</sup> blood.

But

1. If Rh<sup>+</sup> blood is transfused to Rh<sup>-</sup> then 1<sup>st</sup> blood transfusion is complete successfully but during 1<sup>st</sup> blood transfusion Rh antibodies are formed in receiver's blood so in next blood transfusion, agglutination (Clumping) of blood takes place.

O<sup>-</sup> —→ universal donor.

AB<sup>+</sup> —→ universal acceptor.

2. If mother is Rh<sup>-</sup> & father is Rh<sup>+</sup> then offspring may be Rh<sup>+</sup>. In this case 1<sup>st</sup> pregnancy is completely successful but during at the time of 1<sup>st</sup> delivery Rh antibody is formed in mother's blood due to damaged blood vessel so in next pregnancy death of foetus will occur in the earlier stage due to agglutination of blood called **erythroblastosis foetalis**.

Rh antibodies are given to mother with 72 hrs to destroy foetal RBC which prevent Rh-antibodies formation in mother.

**TABLE 18.1 Blood Groups and Donor Compatibility**

<b>Blood Group</b>	<b>Antigens on RBCs</b>	<b>Antibodies in Plasma</b>	<b>Donor's Group</b>
A	A	anti-B	A, O
B	B	anti-A	B, O
AB	A, B	nil	AB, A, B, O
O	nil	anti-A, B	O



<b>Blood Group</b>	<b>Antigens</b>	<b>Antibodies</b>	<b>Can give blood to</b>	<b>Can receive blood from</b>
<b>AB</b>	<b>A and B</b>	<b>None</b>	<b>AB</b>	<b>AB, A, B, O</b>
<b>A</b>	<b>A</b>	<b>anti-B</b>	<b>A and AB</b>	<b>A and O</b>
<b>B</b>	<b>B</b>	<b>anti-A</b>	<b>B and AB</b>	<b>B and O</b>
<b>O</b>	<b>None</b>	<b>anti-A anti-B</b>	<b>AB, A, B, O</b>	<b>O</b>

## ADDITIONAL INFORMATION

1. Packed cell volume (PCV) :- % volume Total number of blood corpuscles in blood.
2. Haematocrit volume :- % volume or only number of RBC in blood.
3.  $PCV \approx HV$   
because 99% of packed cell volume is contributed by RBC & in rest 1% WBC & Platelets are present.
4. In RBC carbonic anhydrase enzyme is present which increases rate of formation & dissociation of carbonic acid by 5000 times. (Fastest catalyst (with zinc))
5. 1 gm Hb carries 1.34 mL  $O_2$ .
6. 100 ml blood contain 15 gm Hb.
7. 100 ml blood transport 20 mL  $O_2$ .
8. **Size of RBC**  
Largest RBC – Amphiuma 75-80  $\mu$  (Class Amphibia)  
Smallest RBC – Musk Deer 2.5 $\mu$ . (Class : Mammalia)