Blood & Its Components - III

Course on Human Physiology: Body Fluids & Circulation

Dr Amit Gupta • Lesson 3 • Sept 7, 2021

WBC

- WBC (While Blood Corpuscles) are also called as **leucocytes** because they are colourless. **TLC**-Total leucocyte count. Number of WBC/mm^3 → 6000 – 8000/mm^3 (± 2000–3000)

Leucocytosis :- Increase in TLC. This condition occur in bacterial & viral infection.

Leucocytopenia :- Decrease in TLC. Normally TLC increases in bacterial & viral infection but in typhoid & AIDS. TLC decreases.

Leukemia :- Abnormal increase in TLC (more than 1 Lakh) it is called as blood cancer.

- **On the basis of nucleus & nature of cytoplasm, Leucocyte are of two types.**

(1) Granulocytes

1. In their cytoplasm granules are present which can be stained by specific dye.
2. Nucleus is multilobed and lobes interconnected by protoplasmic strand.
3. Due to presence of lobed nucleus they are called as polymorphonuclear WBC.
4. Produced in Bone marrow –

They are (i) Acidophils, (ii) Basophils & (iii) Neutrophils

(2) Agranulocytes

1. Cytoplasm is clear and agranular.
2. Nucleus do not divide in lobes so called as mononuclear WBC.
3. Produced in bone marrow.
4. They are of 2 types (i) Monocytes (ii) Lymphocytes

N>L>M>A>B

WBC

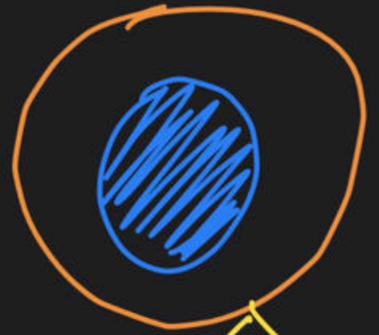
Granulocyte

- Acidophil or Eosinophil

- Basophil
  Smallest

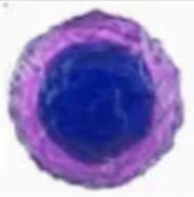
- Neutrophil

Agranulocyte



- Monocyte
  Largest

- Lymphocyte. T, B

Characteristics	Acidophils	Basophils	Neutrophils	Monocytes	Lymphocytes
Size	10–14μ	8–10μ (Smallest granulocytes)	10-12μ	12–20μ	6–16μ
Life span	14 hrs	10 hrs	12 hrs	Less than 24 hrs in blood	5 to 7 days in blood
Stain with	Acidic dye like eosin	Basic dye like methylene blue	any dye (acidic/basic/neutral)		
Shape of nucleus	Bilobed	Two or three lobed, S-shape	3 to 5 lobed	Kidney/Bean shaped	Large due to which cytoplasm becomes peripheral
Function/s	They protect body against allergy and parastic infections.	Secrete and transport heparin, histamine and serotonin	Phagocytic in nature. Destory bacteria and viruses by phagocytosis.	Also called scavengers of blood because they engulf because or dead and minute bits of blood corpuscles.	– T-Killer – direct Lill microbes – T-Helper – Stimulate – B-Lymphocytes to produce antibody – T-Suppersor – Suppresses – T-Killer and protect immune system. – B-lymphocytes – Produce and transport antibodies.
Number	2–3% of TLC	0.5-1% (minimum in no. of TLC)	60–65% (masimum in no.) of TLC	6-8 % of TLC	20-25 % of TLC
Special point	Acidophils increase in a condition called Eosinophilia which occurs during taeniasis, Ascariasis, Hay fever, allergy		– Due to their smaller size and phagocytic nature they are called micropoliceman of blood	Macropoliceman	
Diagram					

TLC = 4000 - 11000 mm3

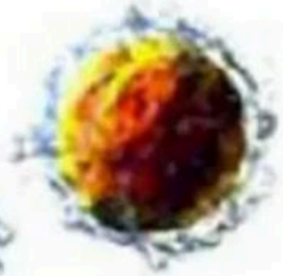
Blood cells and its types with functions

DLC

Monocyte

Eosinophil

Basophil

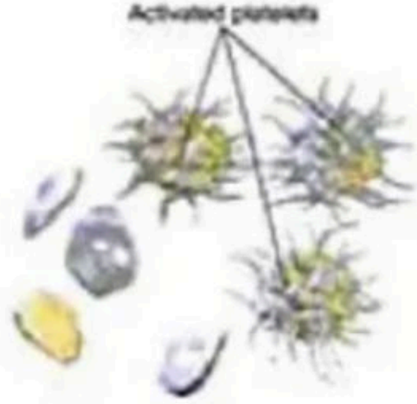


Lymphocytes

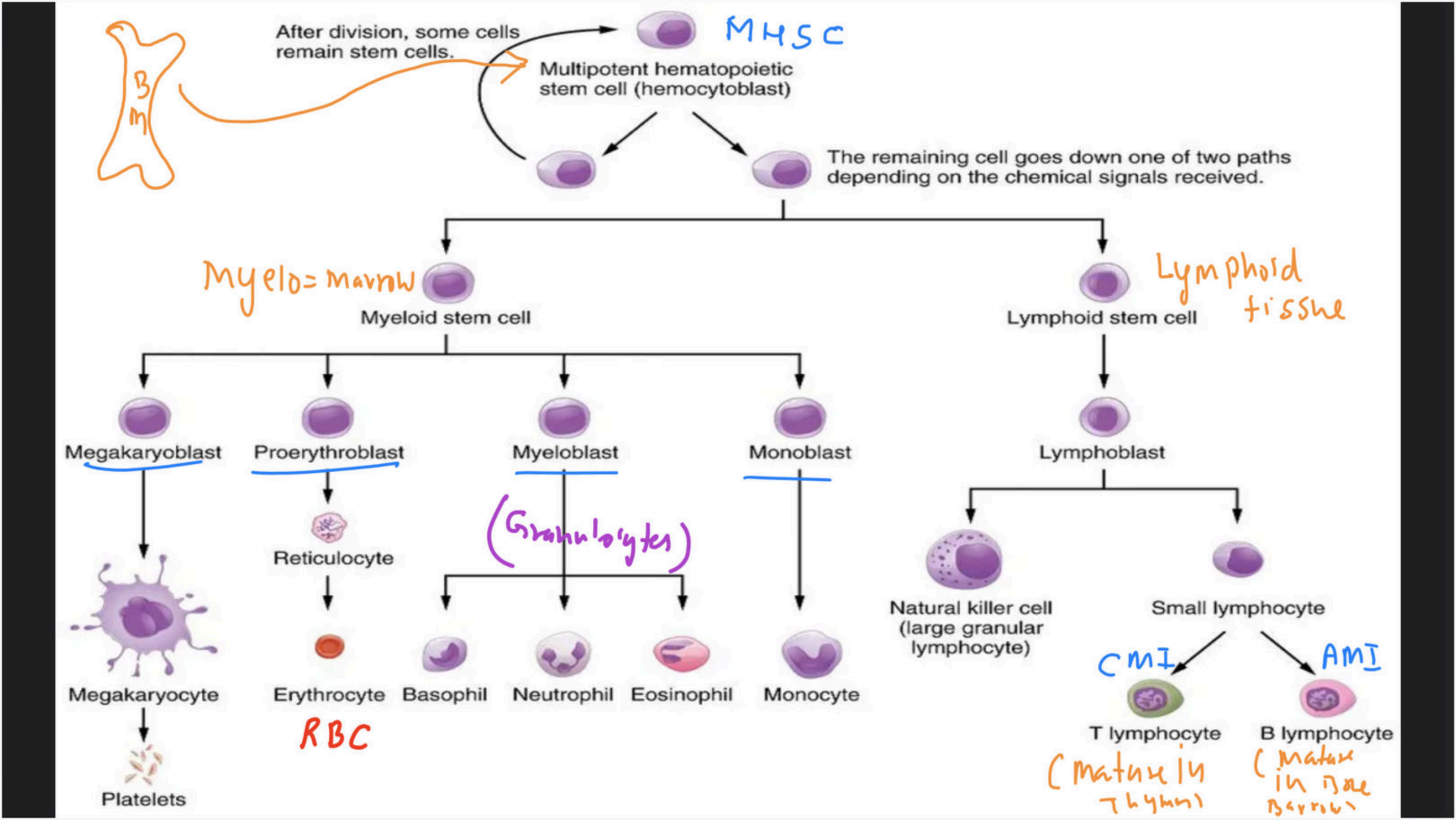
Neutrophil

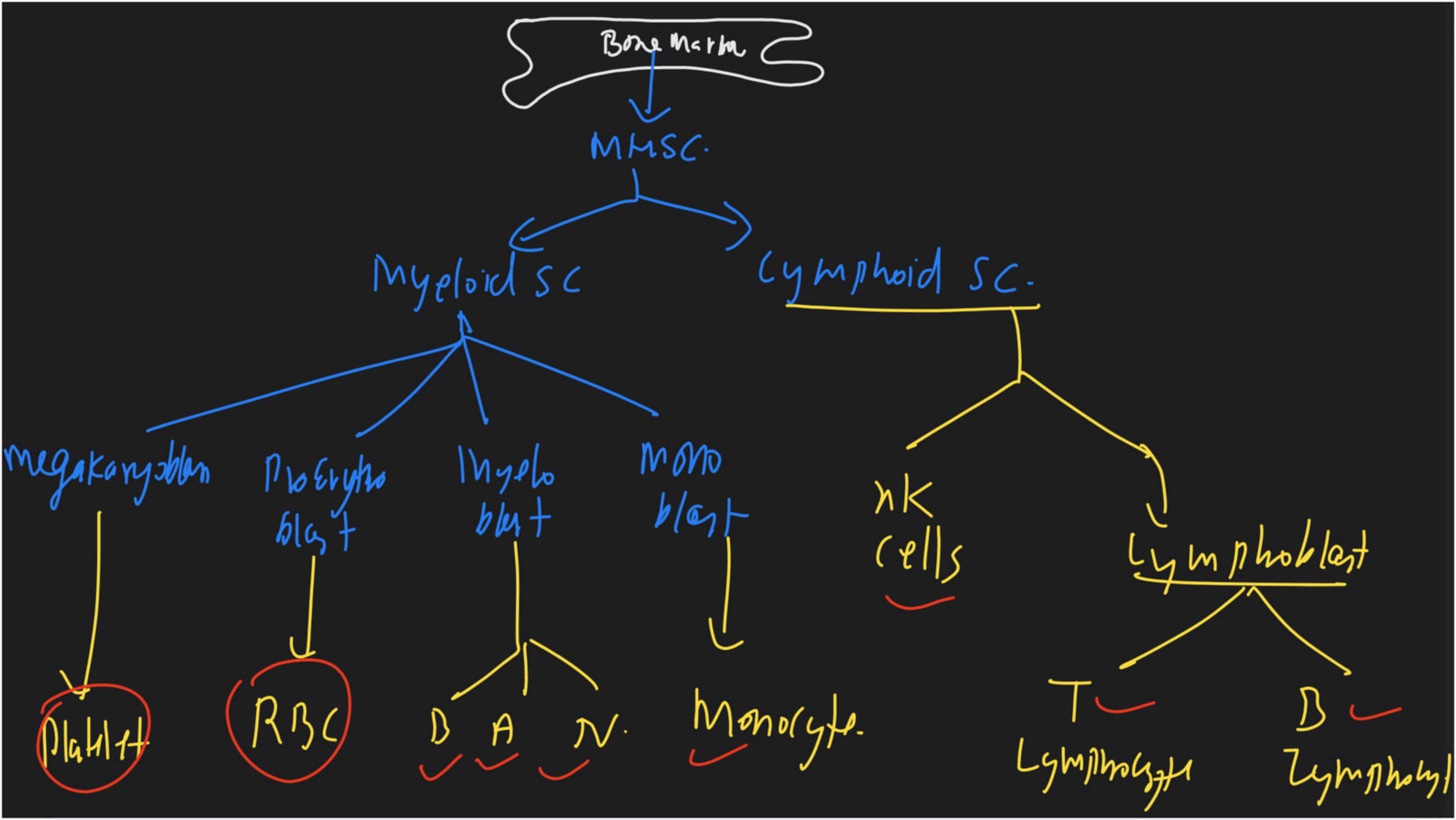
White Blood Cells

Red Blood Cells



Platelets


After division, some cells remain stem cells.
MHSC
Multipotent hematopoietic stem cell (hemocytoblast)
The remaining cell goes down one of two paths depending on the chemical signals received.
Myelo= marrow
Myeloid stem cell
Lymphoid tissue
Lymphoid stem cell
Megakaryoblast
Proerythroblast
Myeloblast
Monoblast
Lymphoblast
Reticulocyte
(Granulocytes)
Natural killer cell (large granular lymphocyte)
Small lymphocyte
CMI
AMI
Megakaryocyte
Erythrocyte
Basophil
Neutrophil
Eosinophil
Monocyte
T lymphocyte
B lymphocyte
RBC
Platelets


Bone marrow
MHSC.
Myeloid SC
Lymphoid SC.
megakaryoblast
Proerythroblast
Myeloblast
monoblast
NK cells
Lymphoblast
Platelet
RBC
B A N.
Monocyte.
T Lymphocyte
B Lymphocyte

PLATELETS

1. Size 2-3 μ.
2. Life span – 2-4/5 days.
3. Count - 1.5 - 3.5 lakh/mm^3.
4. Also known as **Thrombocytes**
5. They are non nucleated and derived from **megakaryocte** cells of bone marrow.
6. In shape platelets are disc like, oval shaped or biconvex.
7. In their cytoplasm basophilic granules are present which can be stained by methylene blue.
8. Maximum part of cytoplasn is composed of contractile protein **Thrombosthenin**.
9. Decrease in number of blood platelets is called **Thrombocytopenia**.
10. Critical count of thromocytes is 40,000/mm^3. If number is less than critical count then red sopt or rashes appears on the skin called **Purpura disease**.

Function

1. Repair endothelium of blood vascular system by the formation of platelet plug because they have tendency to attach on gelatinous or mucilaginous surface.
2. Synthesis thromboplastin which help in blood clotting.
3. Synthesis serotonin (5-hydroxytriptamine).

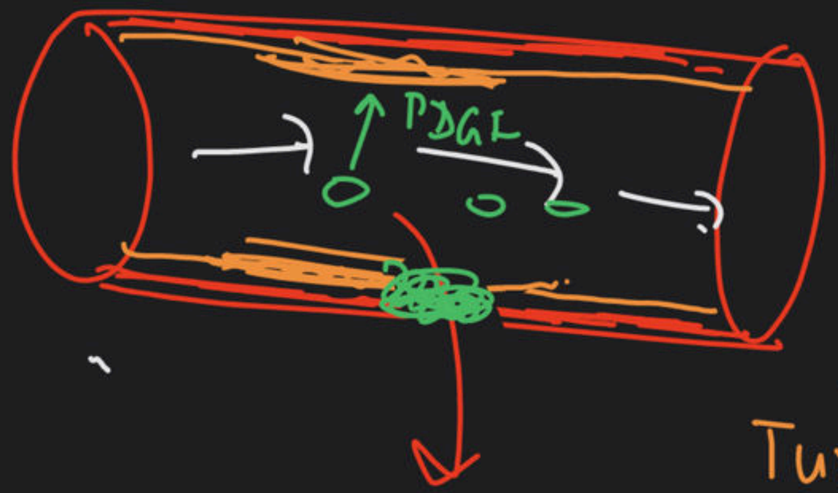
Functions of Platelets

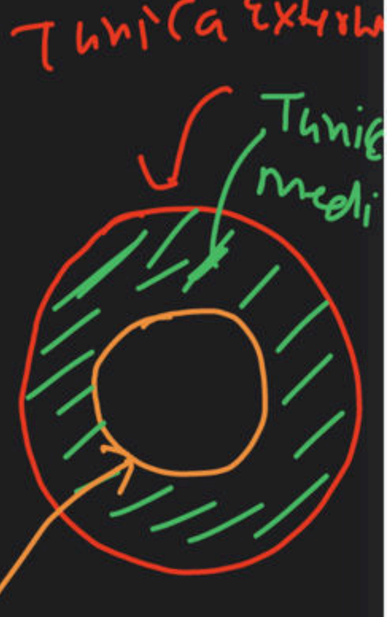
1. Repair of Endothelium

Platelet derived Growth factor.

2. Synthesis of serotonin

3. Help in Blood Clotting





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	–	Protherombin
III	–	Thromboplastin
IV	–	Ca^{+2} (cofactor in each step of blood clotting)
V	–	Proaccelerin
VI	–	Accelerin (Rehected)
VII	–	Proconvertein
VIII	–	AHG (Anti Haeomophelic Globulin) (Absent in haemophelic-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).

BLOOD CLOTTING

- Blood flow cut or wound but after some times is 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.

Ambolus clot

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

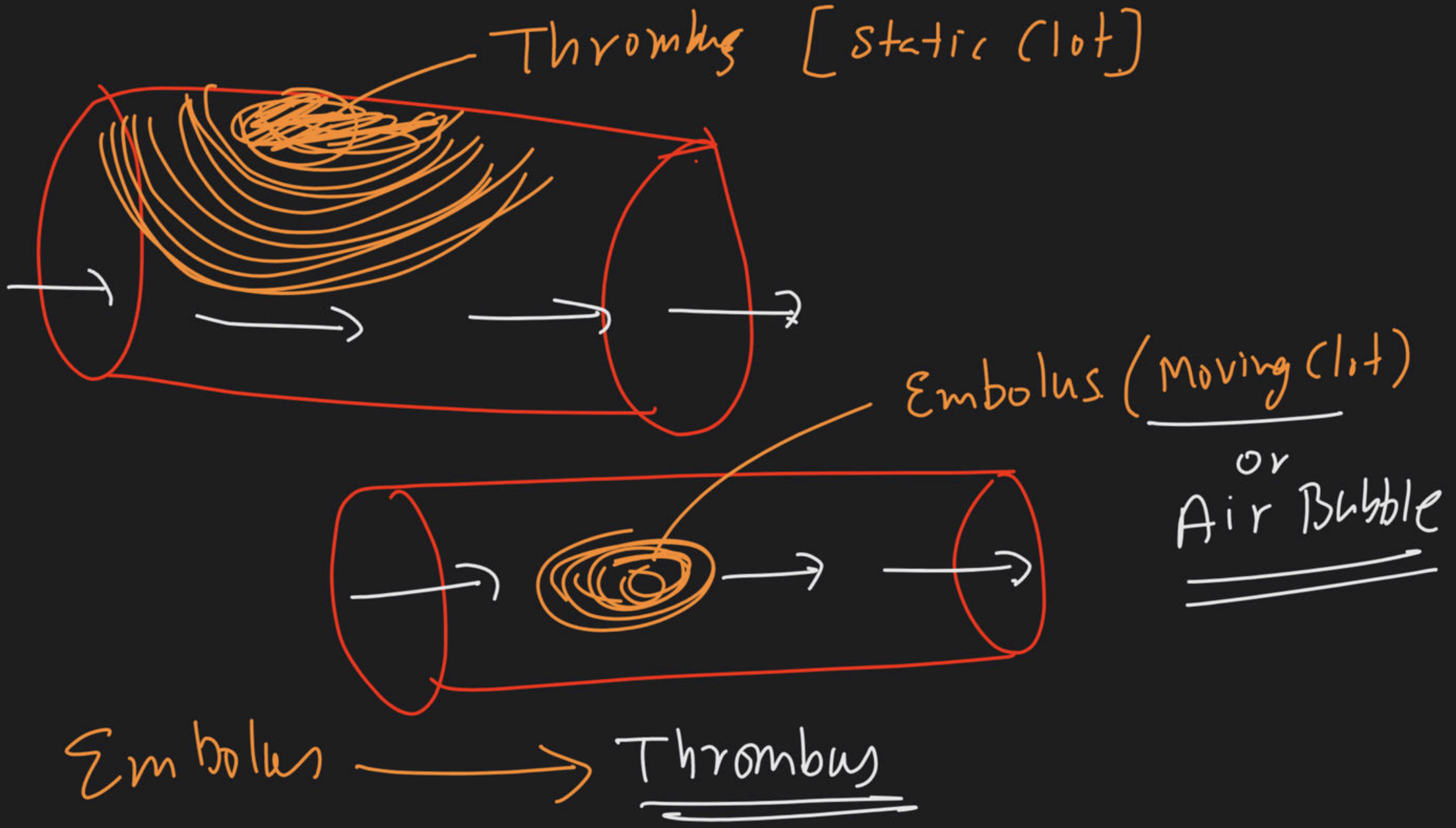
Mechanism of blood clotting

(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 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 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.


Thrombus [static clot]
Embolus (Moving clot)
or
Air Bubble
Embolus → Thrombus

BLOOD CLOTTING

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

Injury → Bleeding Stop!

Injury → Clot formation.

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Embolus clot (Embolus)

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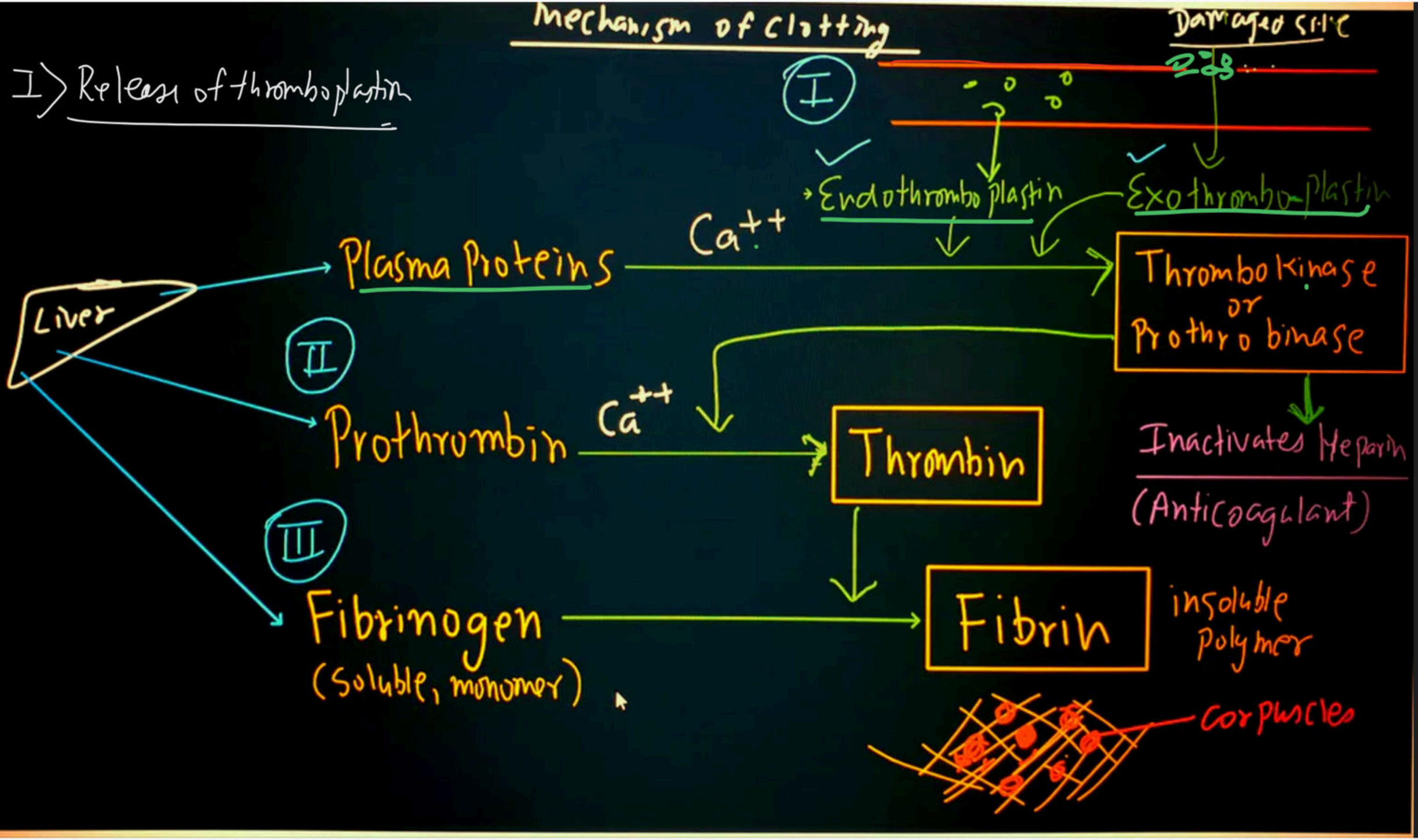
Platelet ⇒ Endothromboplastin

Exothromboplastin ⇐ injured site

Mechanism of Clotting

I) Release of thromboplastin



Clotting factors – Fresher's Party Tonite Come Lets Sing And Call Seniors Please Have Fun

- F – Fibrinogen
- P – Prothrombin
- T – Tissue factor
- C – Calcium
- L – Labile factor
- S – Stable factor
- A – Anti-hemophilic factor
- C – Christmas factor
- S – Stuart prower factor
- P – Plasma thromboplastin
- H – Hageman factor
- F – Fibrin stabilizing factor
- Note – 6th factor not known

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**.

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