

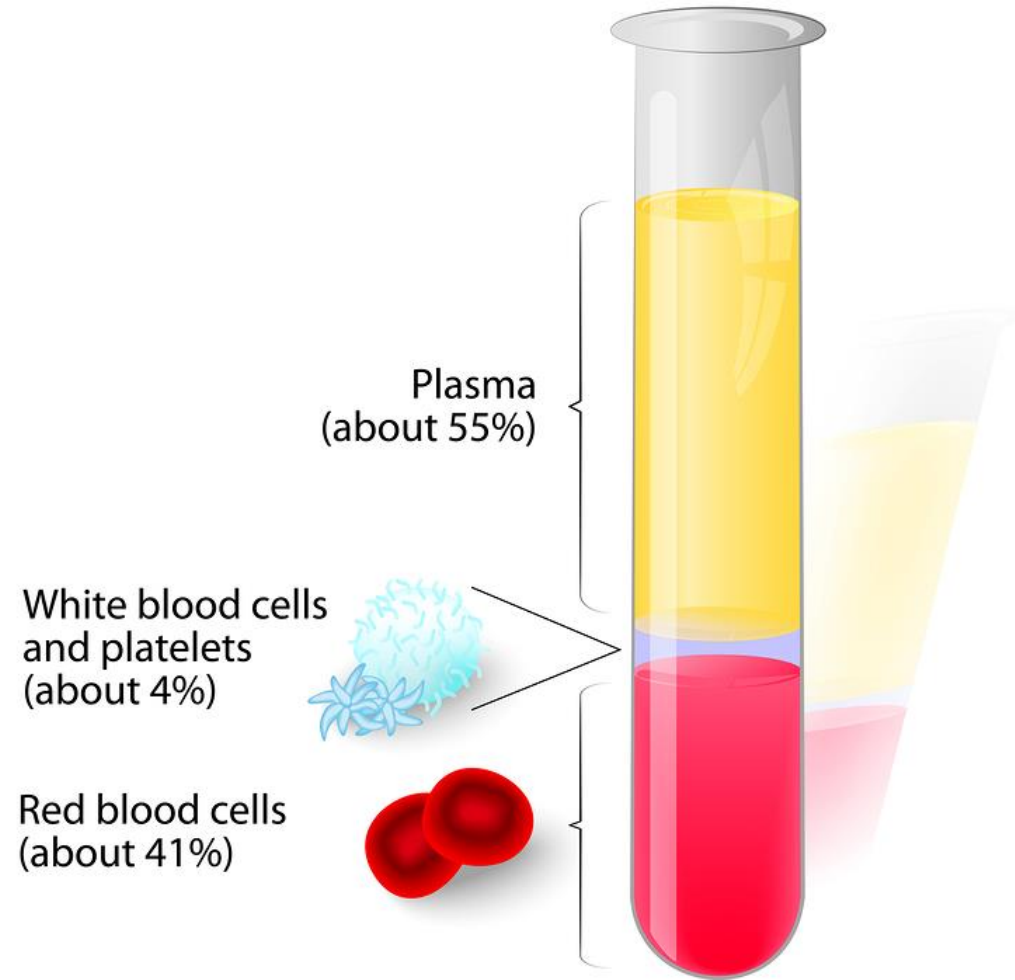
Physiology

Topic : Circulation

Dr. Anu Baburaj P.V.

Circulatory system

Composition of blood



Plasma proteins



Major Types:

■ Albumin (60%)

Major component of osmotic pressure of plasma

■ Globulins (35%)

Antibodies (immunoglobulin) and transport proteins

■ Fibrinogens (4%)

Functions in blood clotting

■ Other (<1%)

Various roles (α -1-antitrypsin, coagulation factors, etc.)

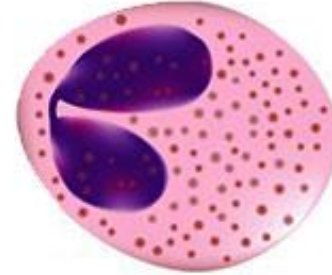
Formed elements of blood



Erythrocytes



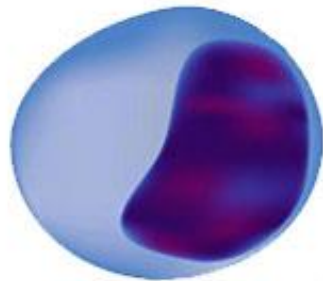
Monocyte



Eosinophil



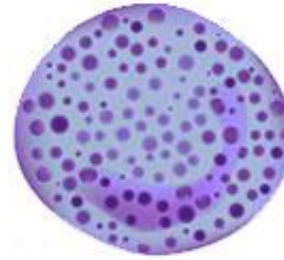
Platelets



Lymphocyte



Neutrophil



Basophil

RBC

- 4.5 to 6 million/cubic mm of blood
- Non- nucleated, circular, disc like and biconcave
- Life span 120 days
- Production controlled by erythropeoetin
- Polycythemia (high RBC count)
- Anaemia (low RBC count)

WBC

- 5000 – 8000/cubic mm of blood
- Lifespan – 4 – 12 days
- **Granulocytes** – granulated with lobular nucleus
- **Agranulocytes** – non-granular with homogeneous cytoplasm
- Neutrophil and monocyte – phagocytes
- **Diapedesis** – oozing out of macrophages through capillaries

WBC - functions

- Basophil (0.5 – 1%) – secrete heparin, histamine and serotonin
- Eosinophil (1.5 – 3%) – combat allergens
- Neutrophils (50 – 70%) – first line of defence
- Monocytes (4 to 7%) – phagocytic
- Lymphocyte (25 – 35%) – humoral and cell mediated immunity

Platelets

- Colourless and non-nucleated
- 200,000 to 400,000/cubic mm of blood
- Formed in red bone marrow from megakaryoblasts
- Life span – 5 to 9 days
- High count of platelets – thrombocytosis
- Low platelet count - thrombocytopenia

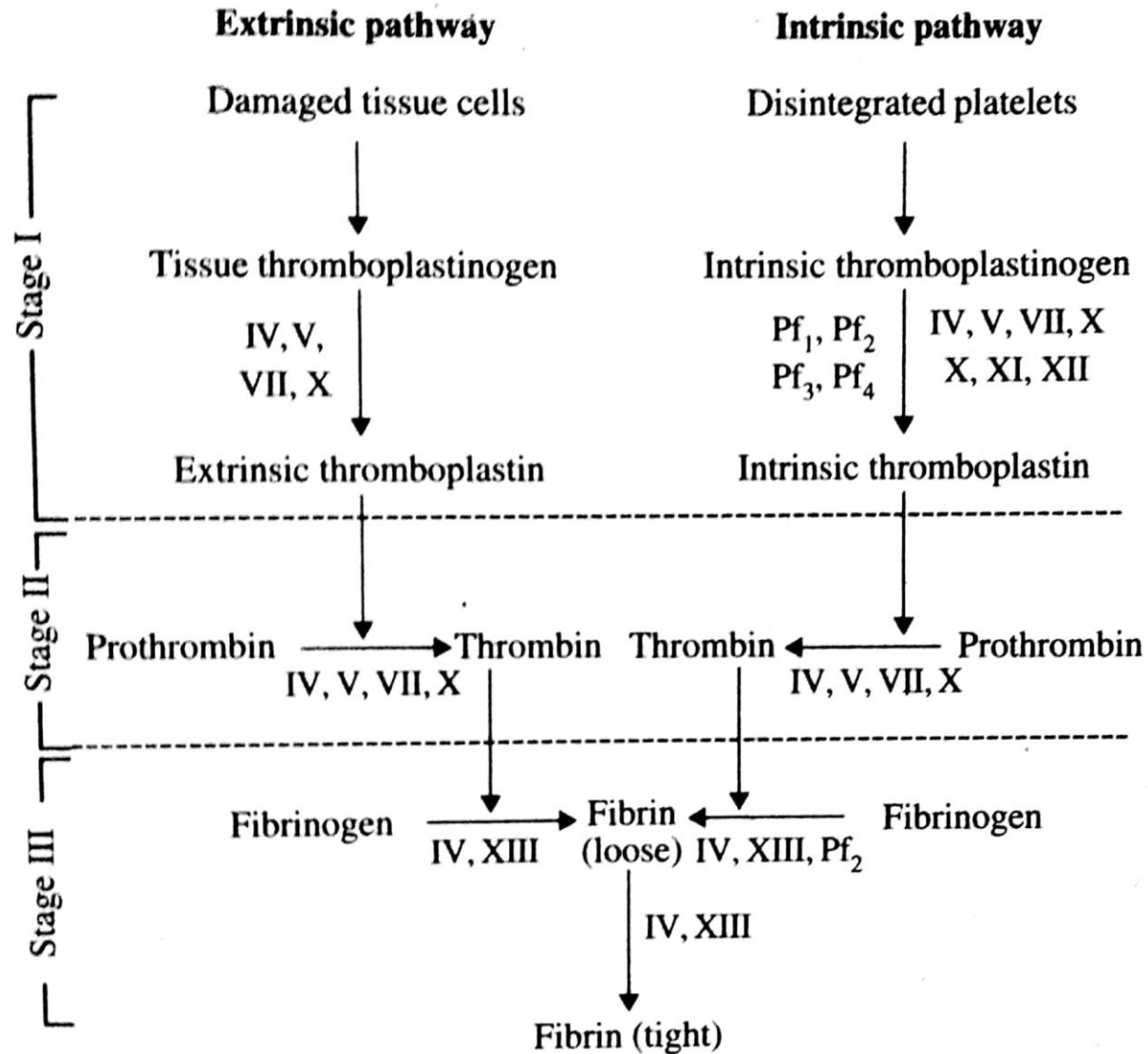
A. Plasma Coagulation factors

Factor and name	Comments
I. Fibrinogen	Synthesised in liver. Important in stage 3 for the formation of fibrin. Plasma minus fibrinogen is called serum.
II. Prothrombin	Synthesised in liver. Formation requires Vit. K. Important in stage 3 for the formation of thrombin.
III. Thromboplastin	Discharged from damaged tissues and broken platelets. Important in stage 2 of extrinsic and intrinsic pathways for the formation of thrombin. Its release marks the end of stage 1
IV. Calcium ions	Important in all the three stages of extrinsic and intrinsic pathways. Absence prevents coagulation.
V. Labile factor (proaccelerin or accelerator globulin).	Synthesised in liver. Essential for stages 1 and 2 in extrinsic and intrinsic pathways.
VI. Accelerin	Has doubtful existence and hence not considered now.
VII. Stable factor (proconvertin or serum prothrombin conversion accelerator – SPCA)	Synthesised in liver. Formation requires vit. K. Required in stage 3 of extrinsic pathway.
VIII. Antihæmophilic factor or globulin (AHF or AHG)	Synthesised in liver. Required for the stage 1 of intrinsic pathway. Deficiency causes hæmophilia A
IX. Christmas factor or plasma thromboplastin component (PTC)	Synthesised in liver. Formation requires vit. K. Necessary for stage 1 of intrinsic pathway. Deficiency causes hæmophilia B or Christmas disease.
X. Stuart factor or Stuart-Prower factor	Synthesised in liver. Formation requires vit. K. Essential for stages 1 & 2 of both the pathways. Deficiency causes bleeding in nose, joints and soft tissues.
XI. Plasma thromboplastin antecedent (PTA) or antihæmo-philiac factor C	Synthesised in liver. Required for stage 1 of intrinsic pathway. Deficiency causes hæmophilia C.
XII. Hageman factor or glass factor	Required for stage 1 of intrinsic pathway.
XIII. Fibrin stabilizing factor (FSF) Laki-Lorand factor	Required for stage 3 of both the pathways for stabilizing fibrin threads.

B. Platelet coagulation factors

- | | | |
|-------------------|--|---|
| Pf ₁ . | Platelet factor 1 or platelet accelerator | Same as plasma factor v. Required in the stage 1 of intrinsic pathway. |
| Pf ₂ . | Platelet factor 2 or thrombin accelerator | Required in the stage 1 of intrinsic pathway. Accelerates the formation of thrombin and the conversion of fibrinogen to fibrin. |
| Pf ₃ . | Platelet factor 3 or platelet thromboplastic factor. | Required for stage 1 of intrinsic pathway. |
| Pf ₄ . | Platelet factor 4 | Required for the stage 1 of intrinsic pathway. Binds the anticoagulant heparin during clotting. |

Coagulation of blood



Agglutination of blood

- Clumping together of RBCs of donor blood in the recipient, during incompatible blood transfusion
- Agglutination results from antigen (agglutinogen) – antibody (agglutinin) reaction

Blood group

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

Universal donor : O -ve

Universal acceptor : AB +ve

A,B,O group discovered by Karl Landsteiner

AB – de Castello and Steini

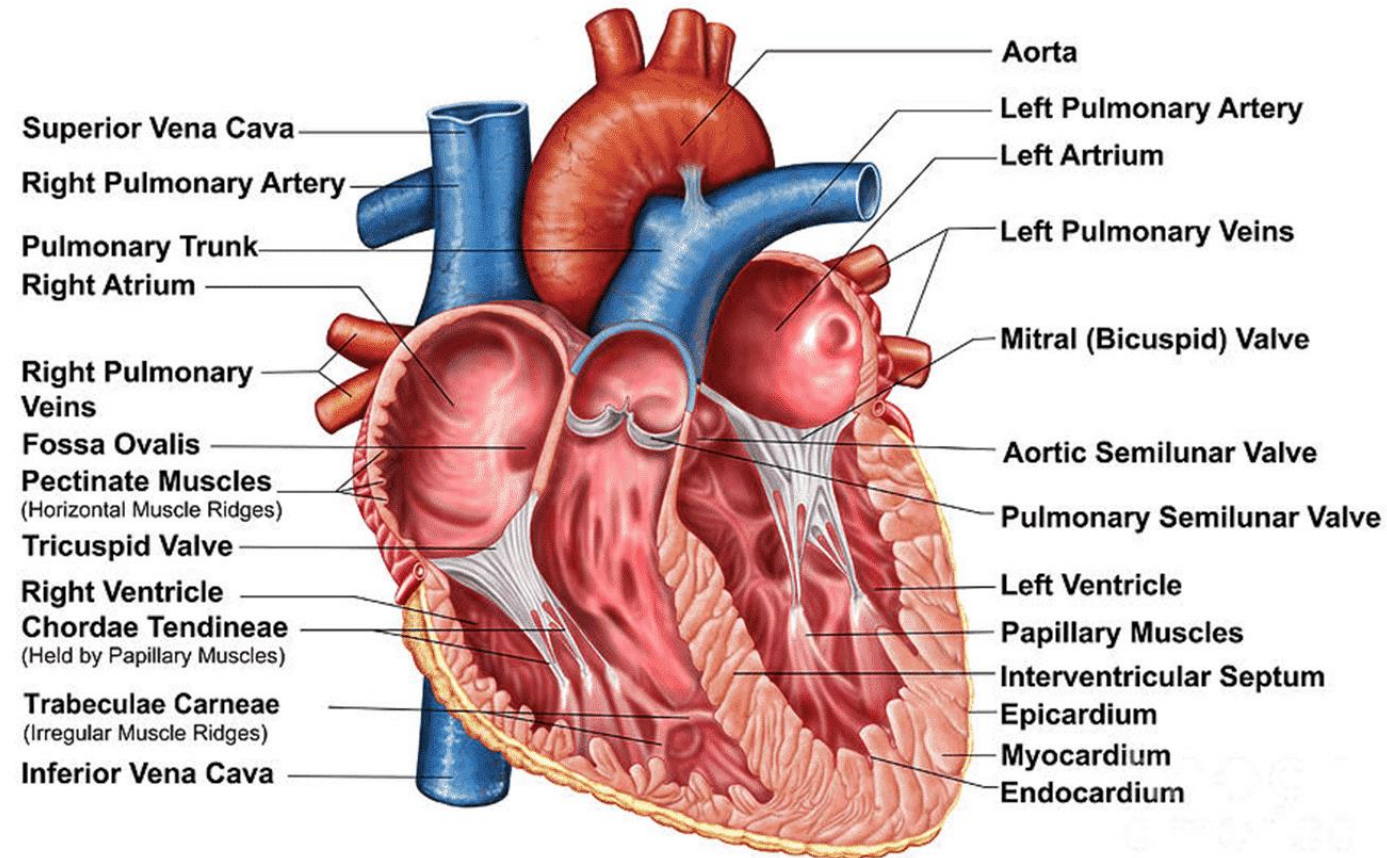
Regulated by gene I on chromosome 9 with 3 alleles

Multiple allelism, co dominance and dominance

Types of heart

- Pulsating vessels
- Tubular hearts
- Chambered hearts
- Accessory hearts
- Myogenic and neurogenic heart

Heart Anatomy



Properties of cardiac muscles

- Presence of intercalated disc
- Tolerance against fatigue
- Automaticity and excitability
- Elasticity
- Rhythmicity
- Conductivity
- Tonicity
- Long refractory period

Nodal tissues

