

## **B.Sc. Part III: Paper V: Group B: Physiology and Endocrinology**

### **Blood Composition**

Blood: It is a fluid connective tissue, which consists of two components

1. Plasma-Fluid matrix-55% of blood volume

2. Blood Cells-Cellular elements-45% of blood volume

#### **Plasma**

- Plasma = (Blood- Blood cells),
- It is the liquid part of blood, in which the red blood cells, white blood cells and platelets are suspended. It is composed of 90-92 % water, 6-8 % plasma protein and 1-2% other substances (glucose, amino acids, electrolytes, ammonia, enzymes, hormones, vitamins, etc).
- The ions proteins and other molecules found in plasma are important for maintaining blood pH.
- Translucent, yellowish, little viscous when centrifuged
- Plasma helps to distribute heat throughout the body and maintain homeostasis.
- Plasma contains 6-8% protein
- Plasma proteins: Helps in maintaining osmotic pressure, coagulation of blood, viscosity, blood pressure, defensive action, transport of gases.
- The solvent property of water helps in transport of nutrients as well as metabolic wastes from one part of body to another part
- Liver produces about 30gm of plasma protein each day.
- They are of three types:

- Albumin: (58-60%) most abundant, main function is to maintain is to maintain plasma osmotic pressure.
- Globulin: (36-38%) – It is important for immunoglobulin. The most important globulin is gamma globulin.
- Fibrinogen: (3-4%) – It helps in blood clotting.
- Electrolytes- Na, K, Cl, Ca, HCO<sub>3</sub>
- Nutrients- Glucose, amino acids, fatty acids, Vitamins & minerals.
- Gases: Oxygen, Carbon dioxide, Nitrogen.
- Waste products: Urea, Uric acid, Creatinine.
- Some of the molecules present in the plasma perform specialized functions, Hormones acts as long distance signals antibodies recognise and neutralize pathogens, clotting factors promote blood clot formation.
- Plasma devoid of its clotting factor is called serum.

### **Blood cells**

Nearly 45% volume of blood consists of blood cells or corpuscles.

These are of three types-

- Erythrocytes or Red blood cells (RBC),
- Leucocytes or White blood cells (WBC)
- Platelets or Thrombocytes

#### **1. Erythrocytes or Red blood cells (RBC)**

- Biconcave, anucleate disc shaped of 7 – 8  $\mu\text{m}$  in size.
- The normal count= 4.5-5.5 lakhs/mm<sup>3</sup>.

- The life span of RBC is 120 days. Old and damaged red blood cells are broken down in the liver and spleen.
- Spleen is also known as graveyard of RBC.
- Red blood cells are specialized cells that circulate through the body and deliver oxygen to the tissues.
- Respiratory pigment, haemoglobin present in RBC helps in carrying oxygen.
- Mammalian RBC do not contain mitochondria and nucleus when mature. These provide space for more haemoglobin, a conjugate protein used in oxygen transport.
- Immature nucleated RBC is called reticulocyte.
- Red blood cells also play an important role in transport of carbon dioxide.
- RBC is produced in bone marrow by the process called Erythropoiesis
- Its production is controlled by the hormone erythropoietin, released by the kidney in response to low oxygen level.

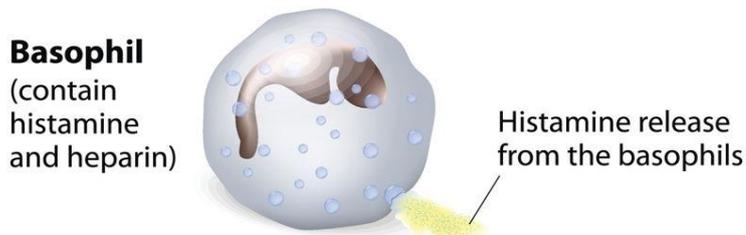
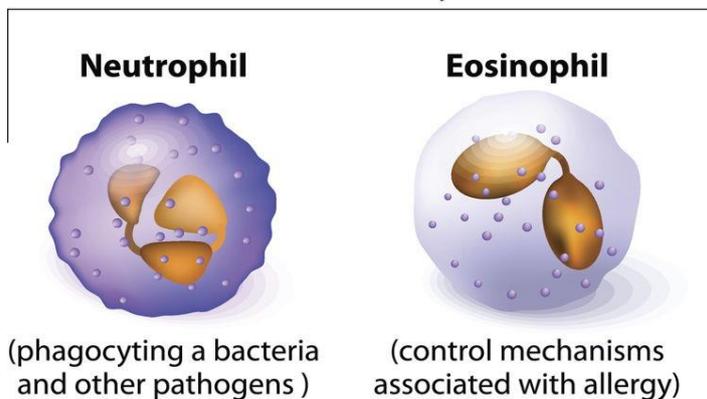
## **2. Leucocytes or White blood cells (WBC)**

- Large size, oval in shape, cell contain nuclei & some of them have granules.
- Normal count-4000-11,000 per mm<sup>3</sup>.
- White blood cells are of five major types, divided in two different groups on the basis of presence or absence of granules.
- 2 types-Granulocytes and Agranulocytes. These differ in size, shape of nucleus, life span & functions.
- Granulocytes includes- Neutrophils, Basophils & Eosinophils

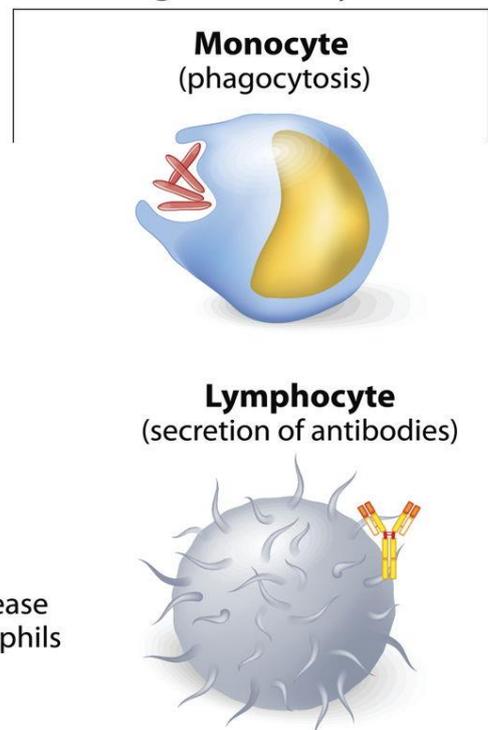
- Agranulocytes include –lymphocytes and monocytes
- Each type of white blood cells plays specific role in defence.

## WHITE BLOOD CELL

### Granulocytes



### Agranulocytes



### Granulocyte-

#### 1. Neutrophils

- It is most abundant WBC (40-70%) of total WBCs.
- It is phagocytic in nature.
- It is the first line of defence against bacteria.
- Phagocytosis by Neutrophil is facilitated by Opsonization by antibody

- The life span is 6 hrs.

## **2. Eosinophils**

- 1-4% of total WBCs
- It destroys parasites & neutralize histamine released during allergic reaction. So, it is increased in parasitic infestation & in allergic reactions.
- It is stained by acidic eosin dye.

## **3. Basophils**

- About 1% of total WBCs.
- It contains basophilic granules.
- It resembles mast cells in connective tissue.
- It contains histamine, heparin & serotonin.
- It is stained by basic dye.

## **Agranulocyte-**

### **1. Lymphocytes**

- 20-40% of total WBCs. It is the smallest WBC.
- There are 2 types of lymphocytes.
- B-lymphocytes is concerned with humoral immunity.
- T- lymphocytes is concerned with cell mediated immunity.

### **2. Monocyte**

- 2-8 % of total WBCs, Have horse-shoe kidney shaped nucleus. It is the largest WBC.
- Life span about 24 hours.

- It differentiates into Macrophages as it enters the tissues which express MHC (Major histocompatibility complex).
- Macrophages in different parts of the body are given different names as follows
- Kupffer cells= liver
- Osteoclast cells= bone
- Microglial cells= brain and spinal cord
- Histiocytes =Connective tissue
- Dust cells (alveolar macrophage) = Lungs
- Hassall's corpuscles= Thymus

### **3. Platelets or Thrombocytes**

These are cell fragments involved in blood clotting.

- They are small disc shaped, about 2-4 $\mu$ m in diameter.
- They are derived from breaking up off the cytoplasm of the Giant cell megakaryotes in the red bone marrow.
- Normal count is 1.5-4.5 lakh/mm<sup>3</sup>.
- average Life span of circulating platelets is 7-9 days.
- Platelet is to help in coagulation. Thromboplastin is secreted by platelets during blood clotting.
- Old platelets are destroyed by the phagocytosis in the spleen and liver.

### **Functions of Blood**

#### **1. Transportation:**

- transport of O<sub>2</sub> from lungs to body tissue and CO<sub>2</sub> from tissue to lungs

- transport of wastes of cellular metabolism from body tissue to kidney, liver or sweat gland and eventually removal out of body
- Transport of hormones, enzymes, other chemicals throughout the body.
- Nutrients absorbed in the digestive tract, such as glucose, amino acids, vitamins, minerals etc and are circulated to all body tissues.
- Waste products of the tissues, such as urea and creatinine, circulate through the kidneys and are excreted in urine.

ii. Regulation (Homeostasis):

- regulate body temperature
- distribution of heat throughout the body

iii. Balance

- Maintaining electrolyte balance
- Maintain acid base balance

iv. Protection:

- protect body from harmful microorganisms, by WBCs, protein and antibody
- develop immune response (plasma protein).