



HUMAN ANATOMY AND PHYSIOLOGY - I

Blood is a connective tissue in fluid form. It is considered as the '**fluid of life**' because it carries oxygen from lungs to all parts of the body and carbon dioxide from all parts of the body to the lungs. It is known as '**fluid of growth**' because it carries nutritive substances from the digestive system and hormones from endocrine gland to all the tissues.

Haematology-branch of science concerned with study of blood, blood forming tissues and disorders associated with blood

PROPERTIES OF BLOOD

1. *Color:* Blood is red in color. Arterial blood is scarlet red because it contains more oxygen and venous

blood is purple red because of more carbon dioxide

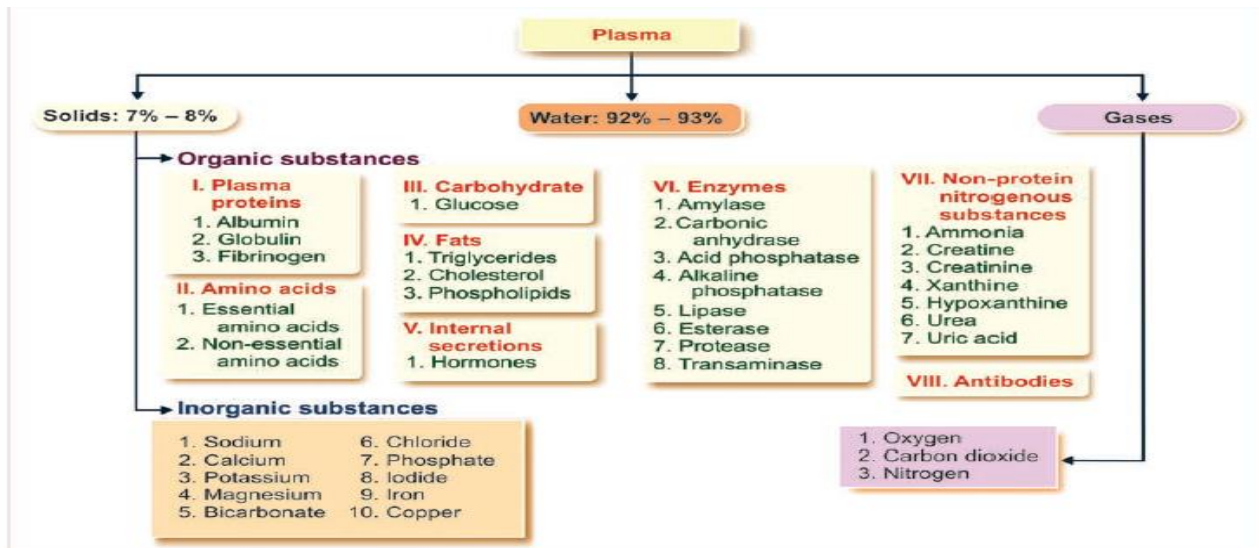
2. *Volume:* Average volume of blood in a normal adult is 5 L. In a newborn baby, the volume is 450 ml. It increases during growth and reaches 5 L at the time of puberty. In females, it is slightly less and is about 4.5 L. It is about 8% of the body weight in a normal young healthy adult, weighing about 70 kg.

3. *Reaction and pH:* Blood is slightly alkaline and its pH in normal conditions is 7.4.

4. *Viscosity:* Blood is five times more viscous than water. It is mainly due to red blood cells and plasma proteins

COMPOSITION OF BLOOD

Blood contains the blood cells which are called formed elements and the liquid portion known as plasma.



„ BLOOD CELLS

Three types of cells are present in the blood:

1. Red blood cells or erythrocytes
2. White blood cells or leukocytes
3. Platelets or thrombocytes.

FUNCTIONS OF BLOOD

„ 1. NUTRITIVE FUNCTION

Nutritive substances like glucose, amino acids, lipids and vitamins derived from digested food are absorbed from gastrointestinal tract and carried by blood to different parts of the body for growth and production of energy.

„

2. RESPIRATORY FUNCTION

Transport of respiratory gases is done by the blood. It carries oxygen from alveoli of lungs to different tissues and carbon dioxide from tissues to alveoli.

„ 3. EXCRETORY FUNCTION

Waste products formed in the tissues during various metabolic activities are removed by blood and carried to the excretory organs like kidney, skin, liver, etc. for excretion.

„ 4. TRANSPORT OF HORMONES AND ENZYMES

Hormones which are secreted by ductless (endocrine) glands are released directly into the blood. The blood transports these hormones to their target organs/tissues. Blood also transports enzymes.

„ **5. REGULATION OF WATER BALANCE**

Water content of the blood is freely interchangeable with interstitial fluid. This helps in the regulation of water content of the body.

„ **6. REGULATION OF ACID-BASE BALANCE**

Plasma proteins and hemoglobin act as buffers and help in the regulation of acid-base balance

„ **7. REGULATION OF BODY TEMPERATURE**

Because of the high specific heat of blood, it is responsible for maintaining the thermoregulatory mechanism in the body, i.e. the balance between heat loss and heat gain in the body.

„ **8. STORAGE FUNCTION**

Water and some important substances like proteins, glucose, sodium and potassium are constantly required by the tissues. Blood serves as a readymade source for these substances. And, these substances are taken from blood during the conditions like starvation, fluid loss, electrolyte loss, etc.

„ **9. DEFENSIVE FUNCTION**

Blood plays an important role in the defense of the body. The white blood cells are responsible for this function. Neutrophils and monocytes engulf the bacteria by phagocytosis. Lymphocytes are involved in development of immunity. Eosinophils are responsible for detoxification, disintegration and removal of foreign proteins

PLASMA

Plasma is a straw-colored clear liquid part of blood. It contains 91% to 92% of water and 8% to 9% of solids. The solids are the organic and the inorganic substances

Plasma proteins are:

1. Serum albumin
2. Serum globulin
3. Fibrinogen.

FUNCTIONS OF PLASMA PROTEINS

Plasma proteins are very essential for the body. Following are the functions of plasma proteins:

„ 1. ROLE IN COAGULATION OF BLOOD

Fibrinogen is essential for the coagulation of blood

2. ROLE IN DEFENSE MECHANISM OF BODY

Gamma globulins play an important role in the defense mechanism of the body by acting as antibodies (immune substances). These proteins are also called immunoglobulins. Antibodies react with antigens of various microorganisms, which cause diseases like diphtheria, typhoid, streptococcal infections, mumps, influenza, measles, hepatitis, rubella, polio myelitis, etc.

„ 3. ROLE IN TRANSPORT MECHANISM

Plasma proteins are essential for the transport of various substances in the blood. Albumin, alpha globulin and beta globulin are responsible for the transport of the hormones, enzymes, etc. The alpha and beta globulins play an important role in the transport of metals in the blood.

„ 4. ROLE IN MAINTENANCE OF OSMOTIC PRESSURE IN BLOOD

At the capillary level, most of the substances are exchanged between the blood and the tissues. However, because of their large size, the plasma proteins cannot pass through the capillary membrane easily and remain in the blood. In the blood, these proteins exert the colloidal osmotic (oncotic) pressure. Osmotic pressure exerted by the plasma proteins is about 25 mm Hg. Since the concentration of albumin is more than the other plasma proteins, it exerts maximum pressure. Globulin is the next and fibrinogen exerts least pressure.

5.ROLE IN REGULATION OF ACID-BASE BALANCE

Plasma proteins, particularly the albumin, play an important role in regulating the acidbase balance in the blood. This is because of the virtue of their buffering action . Plasma proteins are responsible for 15% of the buffering capacity of blood.

„ 6. ROLE IN VISCOSITY OF BLOOD

Plasma proteins provide viscosity to the blood, which is important to maintain the blood pressure. Albumin provides maximum viscosity than the other plasma proteins.

7. ROLE AS RESERVE PROTEINS

During fasting, inadequate food intake or inadequate protein intake, the plasma proteins are utilized by the body tissues as the last source of energy. Plasma proteins are split into amino acids by the tissue macrophages. Amino acids are taken back by blood and distributed throughout the body to form cellular protein molecules. Because of this, the plasma proteins are called the reserve proteins.

RED BLOOD CELLS:

Red blood cells (RBCs) are the **non-nucleated** formed elements in the blood. Red blood cells are also known as erythrocytes (erythros = red). Red color of the red blood cell is due to the presence of the coloring pigment called hemoglobin.

NORMAL SHAPE

Normally, the RBCs are disk shaped and biconcave (dumbbell shaped).

NORMAL SIZE

Diameter : 7.2μ (6.9 to 7.4μ).

Thickness : At the periphery it is thicker with 2.2μ and at the center it is thinner with 1μ

(Fig. 9.1). This difference in thickness is because of the biconcave shape.

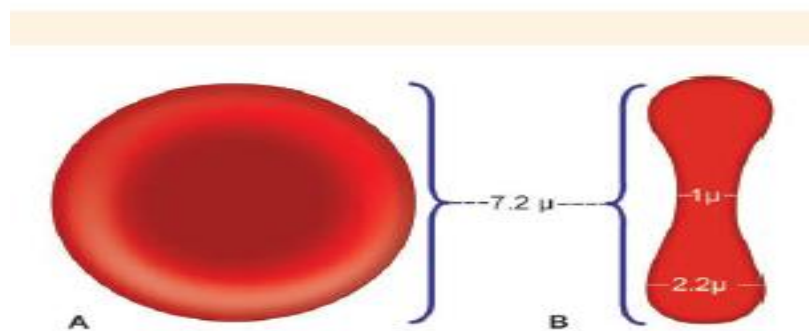


FIGURE 9.1: Dimensions of RBC.
A. Surface view, B. Sectioned view.

NORMAL VALUE

RBC count ranges between 4 and 5.5 million/cu mm of blood. In adult males, it is 5 million/cu mm and in adult females, it is 4.5 million/cu mm.

PATHOLOGICAL VARIATIONS

Pathological Polycythemia

Pathological polycythemia is the abnormal increase in the RBC count. Red cell count increases above 7 million/ cu mm of the blood.

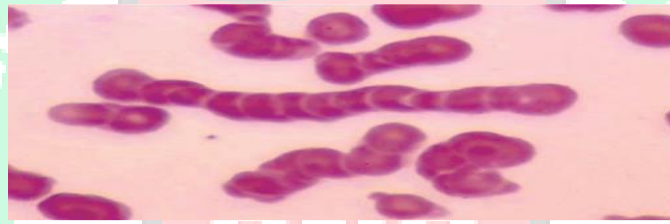
Anemia

Abnormal decrease in RBC count is called anemia

PROPERTIES OF RED BLOOD CELLS

„ ROULEAUX FORMATION

When blood is taken out of the blood vessel, the RBCs pile up one above another like the pile of coins. This property of the RBCs is called rouleaux (pleural = rouleau) formation . It is accelerated by plasma proteins globulin and fibrinogen.



SPECIFIC GRAVITY

Specific gravity of RBC is 1.092 to 1.101.

PACKED CELL VOLUME

Packed cell volume (PCV) is the proportion of blood occupied by RBCs expressed in percentage. It is also called hematocrit value. It is 45% of the blood and the plasma volume is 55%