11. THE BLOOD

The blood is a sticky fluid that transports oxygen from the lungs to the cells, carries food elements from the digestive tract to different parts of the body and carries away waste materials from the cells. Defense cells move in the blood to sites where they are needed to fight infection. Various hormones are also transported in the blood stream. In addition, the blood helps maintain a more or less constant temperature in the body (lie adult man's body contains about five litres of blood. The watery fluid in the blood is called plasma. The plasma contains different types of cells - the RBC's or erthrocytes, the WBC's or the leukocytes and the platelets or the thrombocytes. The plasma makes up around 50% to 60% of the blood. Besides serving as a vehicle for the transportation of RBC's, WBC's, platelets and other substances, plasma also acts in blood clotting and in the defense of the body against disease. After clotting' occurs, a straw-coloured fluid called serum is left. The water in the plasma holds many substances in suspension and solution. These substances include the proteins, products like sugar, fat, inorganic salts derived from food and other storage sites of the body, besides breakdown products of proteins such as urea, uric acid, creatine etc. The plasma also contains enzymes such as adrenal hormones, thyroxine and insulin.

The proteins in the plasma attract water. The proteins in the plasma serve to balance the pulling effect exerted by the proteins in the cells. That is, if the proteins were present only in the cells and not in the plasma, the cells would absorb water into themselves and would be swollen. Serum albumin is the plasma protein concerned with absorption of water. Gamma globulins are proteins that function as antibodies in the blood to immunise the body against disease. The globulin prothrombin plays an important role in the blood clotting mechanism. Another protein called fibrinogen also participates in blood clotting. The salts in the plasma provide many functions. For. e.g., sodium chloride helps in the dissolution of proteins. Some other salts in the plasma called buffers maintain the same degree of alkalinity in the blood.

The RBC's : These are the most numerous of the formed elements of the blood. The RBCs carry oxygen to the cells throughout the body and return carbon dioxide to the lungs. The RBC form in the red marrow of ends of long bones throughout the body and throughout the interior of flat bones like the vertebrae and ribs. The most important chemical of the blood is haemoglobin. It is made up of four parts of heme to ninetv-six parts of globin. In a man, the normal amount of haemoglobin is 14-15.6 gms per 100 CC of blood while in a woman, it is 11-14 gms in 100 CC blood. When haemoglobin combines with oxygen in the lungs after air has been inhaled, it forms a compound called oxyhaemoglobin. When RBC's reach different parts of the body, the parts of the body get oxygen from oxyhemoglobin. Hence, the RBC's draw oxygen from the lungs and transport it in the bloodstream to various tissues. In high altitudes, since there is lesser oxygen,' the body needs more RBC's to carry oxygen to different cells. Hence in higher altitudes, the people have more haemoglobin in their blood. The average life-span of RBC's is 110-120 days. Various methods are used to determine the total number of RBC's and the total haemoglobin content. For e.g.. RBC's are counted by diluting the blood in sodium chloride solution. The haemoglobin content can be determined by the spectrophotometer.

The WBC's : These constitute the chief defence mechanism of the human body. The number of WBC is one for 400 or 500 RBC. The **WBC** unlike the RBC, lack haemoglobin and have a cell nucleus. All WBC's have a life span of less than two weeks. The different varieties of WBC are:

(a) Neutrophils : These are the most numerous of the WBC. The neutrophils attack invading bacteria and also absorb those human cells which have been affected by the invading organisms.

(b) The Lymphocytes: These are the most numerous WBC after neutrophils. They are found in large numbers in the spleen and the lymph nodes.

(c) The Basophils: These have an affinity for a basic dye called Methylene blue. Basophils produce an anti- coagulant called heparin which prevents formation of blood clots.

(d) The Eosinophils : These are stained with the dye eosin. The number of eosinophils increase during diseases like asthma, hay fever and in certain parasitic infections like hookworm.

(e) The Monocytes: These are the largest WBC and form part of the body's defense against micro-organisms, especially in TB, malaria and typhoid.

The Platelets: Platelets are tiny circular or oval disks which are derived from certain giant cells in the bone marrow. The platelets serve many purposes. For e.g.,

when they disintegrate, they liberate thrombokinase or thromboplastin. This plays a vital role in the blood clotting process.

Blood Clotting: Clotting of blood is also called coagulation. In clotting, the blood is first converted into a jelly-like mass. As this process continues, thread-like structures, composed of the protein called fibrin, form a tangled mesh. All the elements of the blood i.e., the RBC, the WBC and the platelets are trapped in this mesh. It may be noted that fibrin is not present in tlie blood but is formed from the union of two substances called fibrinogen and thrombin. Whejl tissues are injured, they release thrombokinase, a clot-inducing substance. This reacts. with the prothrombin of the plasma in the presence of calcium ions to produce thrombin. Finally, the thrombin and fibrinogen react to produce fibrin.

Blood Diseases : The chief types of blood diseases are :

1. **Anaemia :** This is a condition due to deficiency of haemoglobin and hence less oxygen reaches the tissues. There are various types of anaemias. For e.g., nutritional anaemias are due to some malfunctioning of the blood-forming centres or enough of the materials necessary for blood formation may not be present in the diet, or the body may not be able to utilise those materials. Iron-deficiency anaemia is a type of nutritional anaemia in which the RBC's are smaller than normal and fewer in number. Hence, they will not able to carry enough oxygen leading to an oxygen deficiency in the tissues. Women are particularly prone to iron-deficiency anaemia. Achlorohvdric Anaemia is another type of nutritional anaemia. Another type of anaemia is hemolytic anaemia. In this disorder, the RBC are destroyed ton quickly. This condition may either be an acquired or an inherited characteristic. Another type of anaemia is perinicious anaemia. People with perinicious anaemia lack a certain enzyme in the gastric juice, rhis enzyme is necessary for the body to absorb cyanocobalamin or vitamin B_{12} and hence be able to produce RBC's.
2. **Polycythemia:** A serious disorder, polycythemia is a condition in which there is overproduction of RBC's, as a result, the blood becomes thick and moves slowly through the veins. It leads to frequent headaches and dizziness and the blood tends to form clots in the blood vessels.
3. **Leukamia :** This is condition with overproduction of WBC's. The WBC count may reach an amazing total of 5 lakh WBC per cc of blood. The white cells invade the bone marrow, squeeze out the RBC's and platelet producing material and cause an accompanying anaemia to develop. Leukemia is believed to be due to an abnormal condition of the bone mai row or lymphoid tissue, causing WBC-forming elements to multiply.
4. **Clotting Disorders** : If the body is deficient in the essential clotting elements or if the platelets are too few or defective, or if the fibrinogen content of the plasma is seriously reduced, or if there is. a prothrombin deficiency, "clotting disorders with excessive bleeding may result. The different types of clotting disorders are:
   - **(a) Thrombocytopenia :** This results because of too few platelets and hence, the blood tends to seep out of the circulatory system, leading to the development of black and blue bruise spots,
   - **(b) Haemophilia:** This is a hereditary disease, almost exclusively occurring in males and transmitted directly only by females. Due to this disease, even a small cut may lead to serious hemorrhages.

Blood Groups: Each person's blood possesses certain inherited characteristics which distinguish it from the blood of every other person. Human blood can therefore be divided into different groups. The research of Karl Landsteiner led to a clear understanding of blood groups. Landsteiner declared that the formation of clumps in the blood due to the mixing of different blood groups is due to substances called agglutinogens or antigens and agglutinins or the antibodies. A type of agglutinin will cause RBC to clump if the RBC contain a certain type of agglutinogens. Two important types of agglutinogens are labelled A and B. Corresponding to these are two types of agglutinins called anti-A or alpha and anti-B or beta. Clumping of blood takes place if blood containing A is mixed with blood containing anti-B. It may be noted than the RBC of a given person may contain both A and B or either A or B, or neither of them. On the basis OfA, B, anti-A and anti-B, the human blood has been divided into four groups. Those are A, B, O, and AB. An agglutinogen found in the RBC of most people is the Rh factor or the Rhesus Factor. Blood having the Rh factor is called Rh positive and blood lacking it is called Rh negative. If blood from an Rh- positive person is transfused into an Rh-negative person, the serum of the person who is Rh-negative produces an anti-Rh agglutinin. If this person receives some more blood from a Rh- positive person, the anti-Rh agglutinin causes the blood to clump. If an Rh-negative woman becomes pregnant with an Rh-positive baby, the baby inherits the Rh-factor from its father. During pregnancy, some of the RBC of the foetus may enter the blood stream of the mother and cause her blood to produce anti-bodies against the Rh-factor. These

antibodies can enter the foetus and destroy its RBC, a condition called erythroblastosis fetalis. This reaction usually does not occur in the first pregnancy unless the woman has previously built-up Rh-antibodies. Group-O blood may be given to peisons with any group, hence group-0 is called universal donor. Similarly persons with group AB can receive blood from all other groups, hence AB is called universal recipient.

Blood Type Frequency (As a per cent of Total Population)

Blood Type	Frequency (in per cent)
O	46
A	40
B	10
AB	4

Blood Type with Rh Factor Freaeency (As a per cent of Total Populs

Blood Type	Frequency (in per cent)
O Rh-positive (O^+)	38
O Rh-negative (0)	7
A Rh-positive (A^+)	34
A Rh-negative (A^-)	6
B Rh-positive (B^+)	9
B Rh-negative (B^-)	2
AB Rh-positiVe (AB^+}	3
AB Rh-negative (AB^-)	1