10. HAEMATOLOGY

Haematology is a section of medicine, which deals with **blood**. Blood is the life stream. Without adequate circulation of blood, cells quickly die from lack of oxygen or nutrients, or from an accumulation of waste. Without the protection of white blood cells, antibodies and lymph, a person would be helpless against pathogenic organisms.
The body contains approximately 5 litres of blood, which is transported around in the blood vessels.
The blood performs several important functions:

1. Transportation of oxygen from the lungs to the cells and carbon dioxide from the tissues to the lungs for excretion.
2. Transportation of absorbed nutrients from the alimentary tract to the cells.
3. Conveyance of metabolic wastes from the cells to the organs of excretion, e.g. kidneys, lungs, liver and skin.
4. Maintenance of a normal intestinal fluid volume.
5. Distribution of hormones and other endogenous chemicals that regulate many body activities.
6. Transference of heat from the site of production to the surface of the body.
7. Protection of the individual against excessive loss of blood by coagulation and against injurious agents, such as bacteria and toxins.

The blood is composed of plasma and blood cells.
Plasma is in 90 – 91% made of water, the remaining components are solutes, such as nutrients (amino acids, glucose and lipids), gases (oxygen and carbon dioxide), electrolytes and salts, and cells products such as hormones, enzymes, urea, uric acid and creatinine. In addition, there are also blood proteins, anticoagulants, clotting factors and antibodies. Three types of plasma proteins comprising of the greater part of the solutes are: albumin, globulin and fibrinogen. They have many important functions as to transport many substances circulating in the blood, maintain the blood at a slightly alkaline pH of 7.4, provide viscosity to the blood, help in the blood coagulation to prevent excessive loss of blood, blood clotting and others. Blood circulating in normal healthy vessels does not usually clot, unless there is damage to the vessel walls that may trap platelets that may in turn form a **clot (thrombus)**. If the thrombus or a part of it

becomes detached and moves freely in the circulation, it is termed **embolus**.
In starvation, the plasma proteins may be broken down and used as a source of amino acids for the tissues.

Blood Cells
The other composition of blood includes a) the **red blood cells** (erythrocytes), b) the **white blood cells** (leucocytes) and c) the **blood platelets** (thrombocytes).

a) Erythrocytes
The volume percentage of erythrocytes in the blood is about 45 – 50, and is expressed as the packed cell volume or **haematocrit**. There is a slight variation in the normal range between the tissue cells and the lungs.
In every cubic millimetre of blood there are about 5 million red blood cells and each cell contains the pigment **haemoglobin,** which carries the oxygen. When combined with the oxygen, it is a bright red colour and is known as **oxyhaemoglobin**; without oxygen it is a dark red colour known as reduced haemoglobin. **Anaemia** is the term applied to a deficiency of red blood cells or to a lack of haemoglobin.
Erythrocytes are formed in the red bone marrow from the stem cells; this process of formation is called **erythropoiesis**. Factors, necessary for the formation of red blood cells include the presence of erythropoietin, a substance produced by the kidneys, and the dietary factors are also important: proteins, vitamins C and B12, folic acid, iron, traces of copper and a healthy bone marrow. Fully developed red blood cells have no nucleus. They live for about 10 days after which they are destroyed. The iron is then removed to bile pigments **bilirubin** and **biliverdin** which are excreted in faeces via the liver and biliary tract.

b) Leucocytes
The white blood cells are less numerous and larger than the erythrocytes and have nuclei. There are between 5,000 and 10,000 white cells per cubic millimetre of blood; the count tends to be lower after a period of rest and increases following a meal, activity or in most infections in defence of the body.
The leucocytes are into two main groups:

1. Cells that have granules in their cytoplasm – granulocytes,
2. Cells without granules – lymphocytes and monocytes.

Granulocytes
The granular leucocytes are basophils, eosinophils and neutrophils.
Neutrophils defend the body against acute infection and have the ability to move out through the capillary walls into the tissue when necessary; this is called diapedesis. They comprise about 60 – 70% of the total white blood cells. When they have been used up, in the process of bacterial destruction for example they die. Pus contains a large number of dead neutrophils.
Eosinophils increase in number in response to allergic states such as asthma, hay fever and worm infections, they live for about 12 to 24 hours.
Basophils are very small in number (only about 0.4 %) and produce heparin and histamine. They have the least distinctive lobules of the nuclei of all of the granulocytes.

Lymphocytes
The lymphocytes are smaller than granulocytes and have a large spherical nucleus that fills most of the cell. They are also formed in the bone marrow. They increase in number in response to a chronic infection, e.g. infection, which persists for a reasonable length of time and produce antibodies. Their life span varies, depending on type, from a few hours to 200 days.
Monocytes
They are the largest of the white blood cells, phagocytic, and have a kidney-shaped nucleus. They increase in number in protozoal infections such as malaria.

c) Thrombocytes
The third type of formed element in blood are **platelets**, or thrombocytes. They are essential for blood clothing (*thrombo* means "clot") by releasing of a substance called serotonin that causes vasoconstriction at the site of injury. This function is related to homeostasis. With any slight damage to the inner surface of blood vessels the platelets adhere and aggregate, forming a platelet plug that prevents blood loss from small holes. This is a normal process that occurs every day. They are the smallest of all the blood cells and each cubic mm of blood contains 250,000 to 5000,000 platelets.

Blood Groups
The blood group, to which a person belongs, is determined by the presence or absence of agglutinogens (antigens) carried on the surface of red blood cells.

Four blood groups have been identified:

	a person has	can give blood to	can receive from
1. group A	only A antigens	A and AB	A and 0
2. group B	only B antigens	B and AB	B and 0
3. group AB	both antigens	AB only	AB, A, B, 0 (univers. receiver)
4. group 0	no antigens	A, B, AB, 0	0 only (universal donor)

Replacement of blood with that from another person is called **transfusion**. A transfusion of blood that does not match the patient's blood causes a reaction (agglutination, or clumping), which can be fatal; antigens in donor blood act as foreign proteins and stimulate antibody formation.
Another antigen, present in the blood in about 85% of the population is called **Rh factor** (rhesus). Persons whose blood contains this antigen (antigen D) are Rh-positive, the others are Rh-negative. A person who receives a transfusion from an Rh-positive donor, a severe reaction occurs; but a person with Rh-positive blood can receive Rh-negative blood. Rh factor is especially important to women who are Rh-negative and married to an Rh-positive man. During pregnancy, if the foetus is also positive, the mother's blood forms antibodies against the Rh factor. In subsequent pregnancies these antibodies in the form of immunoglobulin immediately follow the first delivery and in all next pregnancies.
The commonest conditions affecting the blood include the anaemia and leukaemia.
Anaemia is said to be present when there is a reduction in the number of red blood cells and the oxygen-carrying substance haemoglobin. There