The Blood

Distribution of fluid in the body :

1- *Intracellular fluids* (50 % of body weight)

2- *Extra cellular fluids*

a-Interstitial fluid which include ,lymph, cerebrospinal fluid, synovial fluid, Bile fluid of the eyes (15% of body weight) .

b-Blood plasma (5% of body weight) .

Blood :

Consist of the cells and fluid that flow in a regular unidirectional movement within the closed circulatory system blood made up of two parts :

a-formed elements (blood cells) .

b-plasma .

Blood :

1-formed elements (cells)

a-Leukocytes

*granulocytes (Neutrophils ,Eosinophils , Basophils)

*A granulocytes (Lymphocytes, Monocyes)

b-Erythrocytes

c-Platelets

2-Plasma

Plasma :

Is aqueous solution in which the blood cell are suspended it is translucent, yellowish, viscous. supernatant .obtained after centrifuge of the blood .is weakly basic, constitute 55% of the blood the cellular elements constitute 45% function is to transport all the substance product digestive system to the tissue and the waste duct and metabolite from the tissue .plasma also transport hormones, plasma contains dissolved gases inorganic salts, protein ,CHO, fats and other organic compounds Amino acids vitamins lipoprotein main plasma proteins in plasma are :

1-Albumin (important for osmotic pressure) .

2-Alpha globulin (transport lipid as lipoprotein) .

Beta globulin (transport lipid as lipoprotein) .

Gamma globulin (immunoglobulin) Antibodies
3-fibrinogen (formation of fibrin for coagulation

Serum :

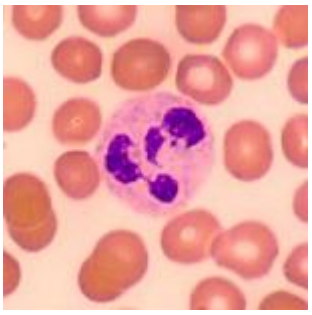
A clear yellow liquid which separates from the coagulation i.e. serum = plasma minus fibrinogen and coagulation factors .

Lymph :

Is the fluid which accumulates from the tissues and return to the blood circulation through lymphatic system . it takes lymphocytes and antibodies when it pass through the lymph nodes . the lymph infiltrated from small intestinal wall has milky appearance due to fatty corpuscles . lymph coagulates slower than blood .

Erythrocytes :

The mature red cells of domestic animals are non-nucleated , concave disks , its function is to transport O2 . the softness and plasticity are due to the colloidal matrix , which allows the erythrocytes to large shape as it courses through blood vessels . then a drop of fresh blood is placed on a slide the cell surfaces adhere to each other and the cells become arranged in long chains similar to a stack of coins the (rouleaux) is a common in horse and cat blood size . dog (7.0 Mm) goat (4.1Mm) . species showing small erythrocytes size have more total erythrocytes count (million / mm3) and these animals with large red cells size have lower nucleus , unit volume . also the total number of erythrocytes depend on breeds nutritional state , physical activity and age .



Structure and composition :

RBC is non nucleated and golgi apparatus , centrioles , and most of the mitochondria disappear before the cell inters the blood stream . the plasma membrane is a lipoprotein complex . 60% of RBC volume consist of water and the remainder 40% is of solids . rearly 90% of the solid material is conjugated protein , composed of globin and the pigment heme . erythrocytes live fore a proximally 120 days and red cells are sequestered in the spleen , bone marrow and liver by phagocytes . the iron of Hb is used in the formation of new erythrocytes , the porphyries portion of the pigment in used to form bilirubin to bile pigment .

Abnormal erythrocytic forms :

1-*Anisocytosis* : in some diseases there is high percentage of erythrocytes with great variations in size and is divided into :

a-*Macrocytes* : excessive large cells the diameter greater than 9mm and is due to acute loss of blood or folic acid and niacin deficiencies

b-*microcytes* : very small cells (less than 6mm) and due to iron deficiency .

these terms are used in the morphologic classification of anemia . Macrocytes anemia is uncommon in animals

2-*Anemia* : is a pathologic condition characterized by blood concentration of Hb below normal value due to either a decreased number of erythrocytes in the blood or decreased concentrate of Hb below normal .

3-*Erythrocytosis (polycythemia)* : an increased number of erythrocytes may be due to physiologic adaptation .

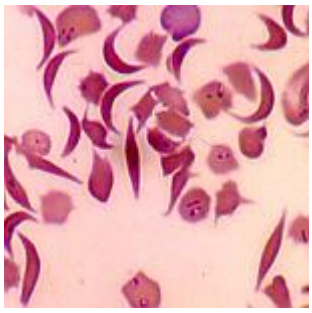
4-Hypochromic anemia (hypochromasia) : reduced amount of Hb and therefore have a marked increase in the central pallor .

5-*Polychromatic* : young erythrocytes in the peripheral circulation exhibit a characteristic muddy-blue color because their cellular constituents have an affinity for both acid and base dyes .

Sickle cell disease :

A pathologic condition due to inherited alterations in Hb molecules . Macrocytes with Howell-jolly body . erythrocyte with punched-out center resulting from changes in shape during blood flow with the

periphery well filled with Hb . bowl or cup-shaped cells in aberrant red cells from which are common to all domestic animals with acute diseases and to some chronic disorders in body .



Leukocytes (white blood cells) :

Are typical cells possessing nucleus , cytoplasm and other organelles and all are motile to some extent , where as the red blood cells are not typical cells (just un nucleated discs with out golgi apparatus or mitochondria or centosomes) and perform their main functions in the blood . leukocytes leave the blood and move into the tissues to carry out their functions . the total number of leukocytes is far less than erythrocytes . great fluctuations in the leukocytes count occur due to stress , age , breed , feeding and a wide variety of other conditions . the five different recognizable types of leukocyte are classed into two main groups based on the presence or absence of specific cytoplasmic granules .

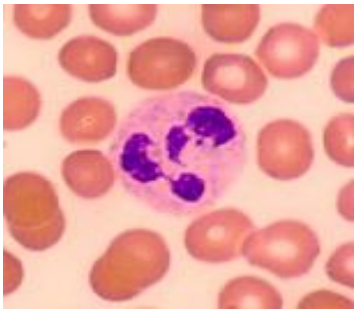
Granulocytes :

The three types of granulocytes are named according to the staining reaction of their specific granules . Eosinophils have definite acidophilic granules (stain red with eosin) . Basophils possess distinct basophilic (purple) granules and neutrophils have granules that either acidophilic non basophilic . the term heterophils is an other name for the neutrophils because it indicates that the granules may stain different from either the eosinophilic or basophilic granules but not necessarily be neutral . the neutrophils is called the polymorph nuclear (pmn) leukocyte because of the variations configurations of the nucleus .azrophilic granules are non specific granules and stain purple are lysosomes . granulocytes have nuclei with 2 or more lobes and include the neutrophils , Eosinophils , and basophils . all granulocytes have a

life spam of a few days dying by apoptosis (programmed cell death) in the connective tissue . it is estimated that billions of neutrophils die by apoptosis each day in the adult human .

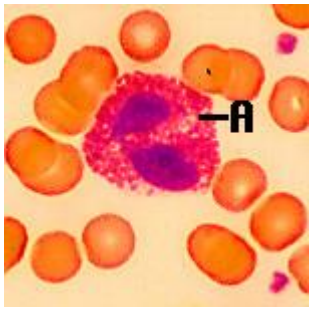
Neutrophil (heterophils) :

The mature neutrophil is approximately 10-12 mm in diameter , neutrophil has fine granules in the cytoplasm with nucleus consisting of 2-5 (usually 3) lobes linked with fine threads of chromatin . the nuclear chromatin is dense , clumped and plagued . old cells have more nuclear lobules than young cells . therefore , neutrophils with V , U , or S- shaped are considered to be immature (band or non segmented cells) . bacterial diseases usually cause an increase in the numbers of circulations neutrophils and many band forms may be present . this increase in young cells is called (a shift to the left) and is a good prognosis sign . conversely , an abnormal number of neutrophils with nuclear hyper segmentation is known as a (shift to the right) and may be a poor prognostic sign , or a sign of chronic infection . the neutrophil cytoplasm is pale grayish blue , containing the dust-like pink granules . in response to infection , neutrophils move from the blood to the affected area and engulf bacteria and tissue debris . neutrophils are considered to be the first line of defense against micro organs species bacteria . (phagocytes) . neutrophils with more than five lobes are called hyper segmented and are typically old cells . in some pathologic conditions . young cells appear with five or more lobes . neutrophils have some times been called microphages to distinguish them from macrophages which are larger cells .



Eosinophil :

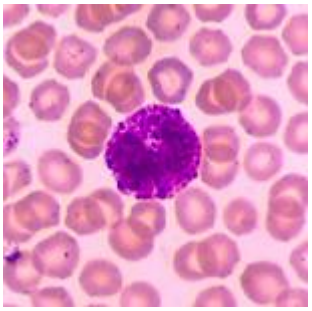
Eosinophils are far less numerous than neutrophils , consisting of only 2-8 % of leukocytes in normal blood . and are 10-15 mm in diameter , and have bilobed nucleus surrounded by prominent acidophilic granules 0.5 to 1.0 mm in size . the two nuclear lobes may not always be connected and are often obscured by the granules . the eosinophilsic granules in domestic animals exhibit divide variations in size , shape , staining reaction and numbers . in the dog only 2or 3 large granules (3-4um) are present with pale –staining similar to the color of erythrocytes . the cytoplasm pale-blue . the cat Eosinophils has granules in numerous rod –shaped granules . the eosinophililic granules in the ruminant stain bright orange . the eosinophil structure of horse has characteristic mulberry- like appearance . the exact function of the eosinophil is not understood eosinophils increase in number in heavily parasitized animals and infiltrate sites of allergic reactions . eosinophils phagocytize antigen – antibody complexes .



Basophil :

Basophils account for 0.5 to 1.5 % of the blood leukocytes and are therefore difficult to locate in smears of normal blood . they are 10 to 12 um in diameter with a bilobed or irregularly shaped nucleus . the large granules (0.5 to 1.5 mm) are dark blue to purple and often obscure the lighter stained nucleus . basophils are usually rare in the blood of the dog and cat . in other domestic animals the granules are large , spherical or oval usually fill the cytoplasm and stain purple . in the cat , the purple granules have a red halo which imparts red ting to the entire cytoplasm . histologically the granules are similar to those of the last cells , they contain heparin and histamine which may be

released in certain allergic condition when immunoglobulin IGM becomes attached to the basophil surface .



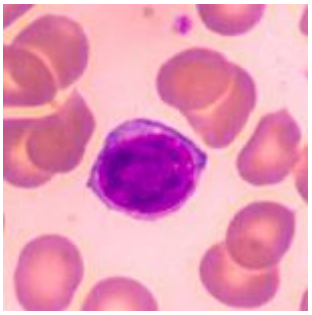
A granulocytes :

The two distinct types of a granulocytes , the lymphocytes and monocytes , are devoid of specific cytoplasmic granules . a granulocytes are further characterized by having a spherical , oval or indented nucleus , but it not lobulated . the blood of the dog , cat and horse contains a greater percentage of neutrophils than of lymphocytes , where as the blood of ruminants the lymphocytes predominates .

Lymphocytes :

The percent of lymphocytes in blood is species dependent , 50-40% in the dog , cat and horse , 60-70% in the ruminant and 50-60% in the pig . there are small and large lymphocytes , the large lymphocytes are a more immature type . lymphocyte has considerable ability to change size and shape and its motile . lymphocyte move throughout the soft tissues and organs , there by providing an immunologic defense for the host . host of the lymphocytes in the blood stream of the horse , pig and carnivores are the small type (about 6-9 mm) in diameter , with a large dense nucleus surrounded by thin rim of pale blue cytoplasm of frequently , the nucleus has a small indentation on one side . the nucleus is not visible as the nucleus is so dense . large lymphocytes (12-15 mm) in diameter have considerably more cytoplasm and the nucleus is less dense than that of the small lymphocytes. Cattle blood has both small and large lymphocytes sheep lymphocytes occur in various sized but there are no definite small and large types the nucleus may be reddish and binucleated . the goat has small , medium- sized and large lymphocytes and the nucleus is usually spherical and occasionally

kidney – bean shaped . the lymphocytes is one of the two most common blood leukocytes , the neutrophil is the other . the major functional features of lymphocytes are the ability to respond to immunogenic substances by synthesizing and releasing antibodies into the blood circulation and to elicit immune responses involving cellular immunity . two additional functions : 1- furnish nutrition to other cells . 2- their ability to convert to any one of the mesenchymal cells e.g. fibroblasts , mast cells , macrophages as well as myeloid elements . there are two functionally different types of circularity small lymphocytes : 1- induce to become immunologically functional and referred to as long – lived recirculatory lymphocytes . 2- with no immune activity one termed short – lived lymphocytes . the majority of the lymphocytes in the blood are the long – lived recirculating variety .



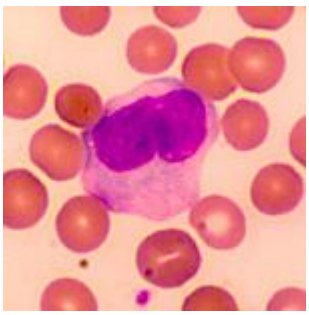
origin of lymphocytes , in early fetal life the lymphocytes are formed from mesenchyme cells of yolk sac . later in fetus they are formed in liver and spleen . these stem (original) lymphocytes migrate to bone marrow . the small lymphocytes produced in bone marrow go into blood circulation and enter the thymus to become T lymphocyte which later have following circulation : Thymus …. Blood stream …. Bone marrow …. or peripheral lymphoid tissues as lymph nodes , spleen , tonsils , peyers patches etc. these thymus treated or T lymphocytes are responsible fore cell mediated immunity . it means that they surround the antigens (foreign protein , bacteria and viruses etc.) and making them ineffective .

Another class of stem lymphocytes from bone marrow dose not enter the thymus , but its processed in bone marrow it self . in birds they are treated in bursa of fabricius therefore they are called B lymphocyte . it is now almost certain that in human beings they are processed in bone marrow it self . therefore the B lymphocytes size responsible fore hum oral immunity in contrast to T lymphocytes which are engaged in cell

mediated immunity . both B and T lymphocytes possess specific antigen receptors on their surface .

Monocytes :

The monocytes is the largest of all the leukocytes 15 – 20 mm in diameter and makes up 7-9 % of the total white blood cells . monocytes cytoplasm is more abundant than that of the lymphocytes and is pale grayish blue . the nucleus may be oval , kidney – bean or horse shoe shaped . the nuclear chromatin stains lighter than that in the lymphocyte . in dog 5% of leukocytes are monocytes , in cat 3% , in cattle 4% in sheep 2.5% , in horse 4% . they are most difficult to differentiate from large lymphocytes . monocytes develop into macrophages in the tissue to clear away tissue debris and foreign substance . any accumulation of monocytes within the tissue reflects chronic conditions .



Thrombocytes (platelets) :

Are small irregularly bodies or non nucleated disk – like cell fragments 2-4 mm in diameter . in the embryo its originate in liver , spleen , bone marrow while in adult platelets originate from the fragmentation of giant polyploidy megakaryocytes that reside in the bone marrow . platelets promote blood clotting and help repair gaps in the walls of blood vessels . normal platelet counts range from 350000 to 500000 micro liter of blood . then stained blood smears platelets often appear in clumps each platelets has a peripheral light blue – stained transparent zone , the hyalomere and a central zone containing dark purple granules called granulomere . . hyalomere contains a circular complex of microtubules and microfilaments which serve a cytoskeletal function . the central zone (granulomere) contains granules and dense bodies which include : ADP, ATP, ATpase , phospholipids , serotonin , hydrolytic enzymes , glycoproteins and thrombosthenin .

these substances are required for coagulation , clot reaction and release reaction . Thrombocytes production controlled by thrombopoietic stimulating factor (TSF) which increase the production of megakaryocytes from the stem cells in the bone marrow . in the poultry and Thrombocytes contain nucleus and has oval shaped , (3-5mm) in thickness and (7-10mm) in diameter .