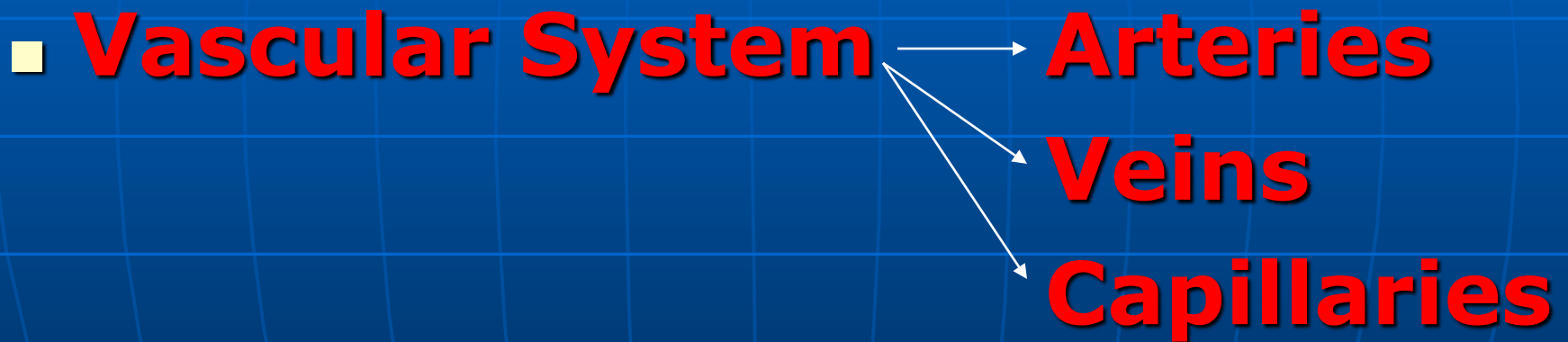


Physiology of Cardiovascular System of Domestic Animals

Dr. Ravindra Kumar

Cardiovascular System

- **Blood**

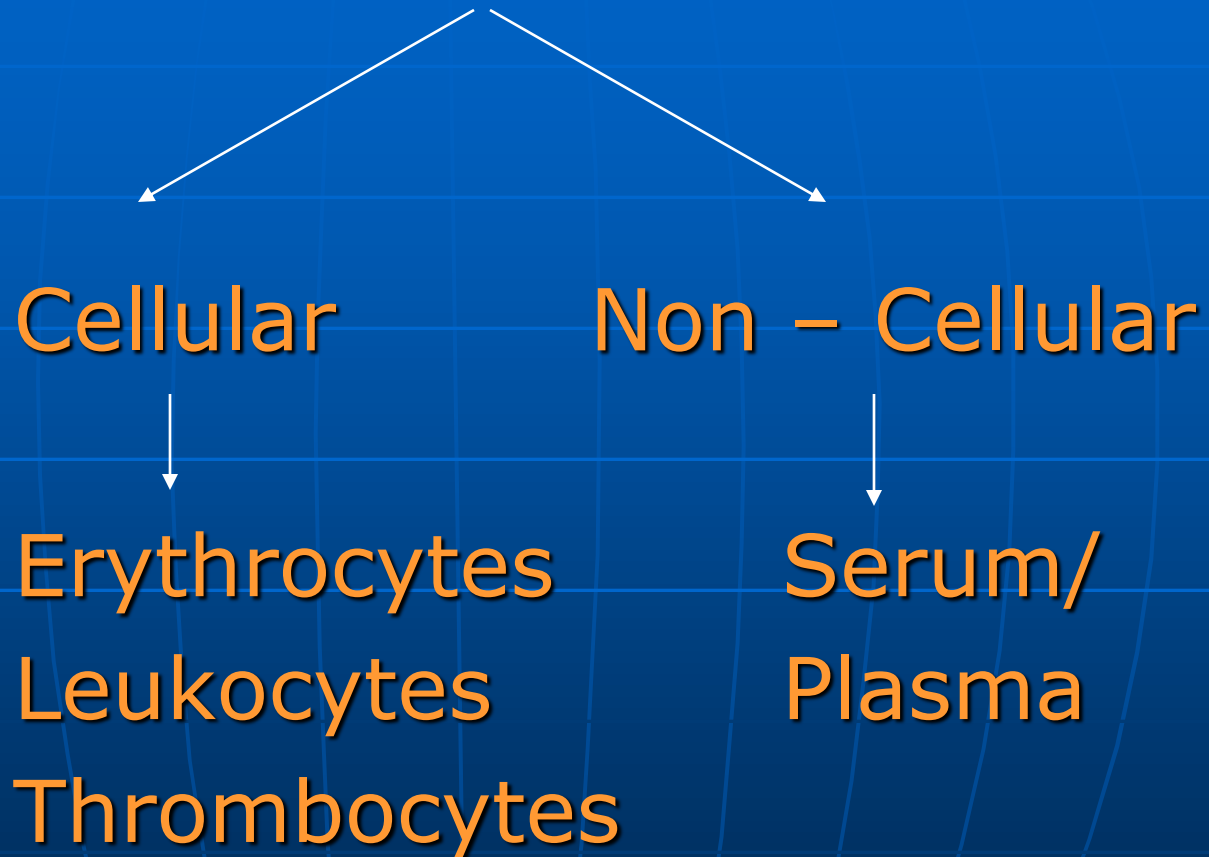


- **Heart**

Blood

- Blood is red coloured semi liquid viscid fluid.
- Blood constitutes about 5 - 7% of total body weight or 2 - 3 litres/ Sq.metre of **body surface area** of the animal

Blood



Blood Composition

Water --- 91 to 92%

Solid matter --- 8 to 9 %

Protein... 7 %

Fats ,fatty acids,cholesterol & lecithin .

Inorganic salts (0.9%) Na, K, Cl, HCO₃, Ca, Mg & Po₄ and micro minerals, Enzymes and Hormones etc.

Plasma Vs Serum

Plasma

Prothrombin &
Fibrinogen present

Serum

Prothrombin &
Fibrinogen absent

BLOOD COAGULATION

Blood is drawn , with out adding anticoagulants clotting factors are converted to active form to form a **clot**. Semi-liquid state of blood is converted to gel like mass, of clot.

- Formation of thromboplastin
- Formation of thrombin
- Formation of fibrin

Formation of Thromboplastin

Factor-VIII (AHG) + Factor III (Platelet)



Intermediate product + AHF (Factor V)

Factor IV

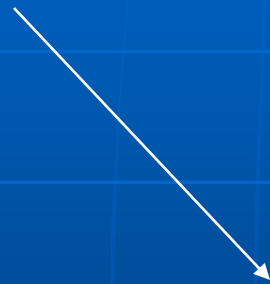
FactorVII



Thromboplastin

Formation of Thrombin

Prothrombin



Thromboplastin

Thrombin

- Thromboplastin immediately acts on inactive prothrombin to convert it into thrombin

Formation of Fibrin

Fibrinogen

Thrombin

Fibrin

Polymerization of fibrin molecule to form a clot in network & formed elements gets entrapped.

Macfarlane theory of blood coagulation

Intrinsic factors

Factor XII / Hageman factor---activated to--> Factor XIIa

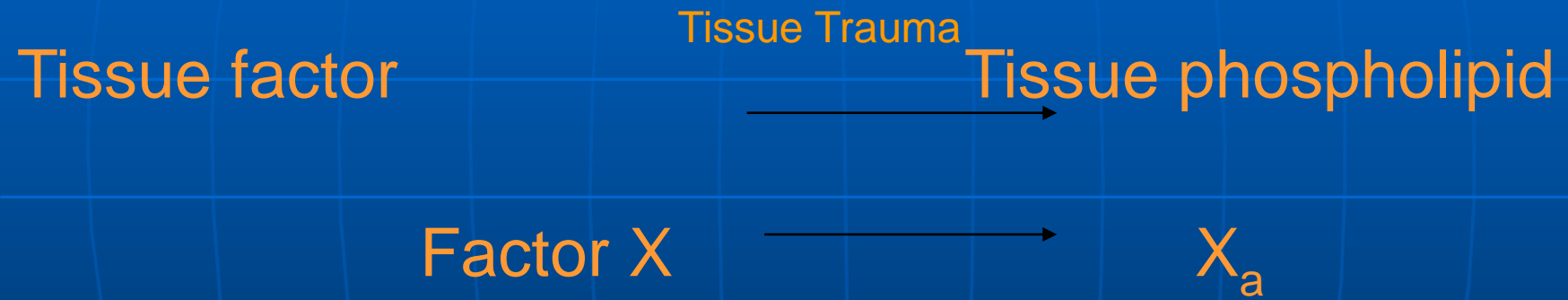
Factor XI-----XIIa acts-----> XIa

Factor IX-----XIa-----> IXa

Factor VIII-----IXa-----> VIII a

Factor X-----VIIIa -----> Xa (Thromboplastin)

Extrinsic Factors



Erythrocytes

RBC's Non- nucleated, biconcave or circular disc shaped.

Average Diameter 4-7 μ .

In hypotonic solution RBC's swells up and becomes ballon shaped and may even rupture leaving behind a mass of ipo_protein.

In hypertonic solution They shrink and appear crenated .

Theories about RBC Structure

- Mass of sponge like material , in the interstices of which , haemoglobin is fixed.
- RBC 'S are vesicles which enclose haemoglobin and other fluid material .
- RBC is a baloon like structure , outer of which is made up of lipo- protein, which encloses haemoglobin .

Erythrocytes are easily **compressible** **elastic** in nature and due to this character they can easily pass through capillaries which have diameter less than erythrocytes.

ERYTHROPOIESIS

Sites of erythropoiesis

- **Prenatal** : Stem cells/Haemocytoblast are present in bone marrow, yolk sac, spleen, thymus, lymph nodes & liver.
- **After birth** : Bone Marrow, but after 20 Years of age large bones, almost stops RBC production and is carried out by the ribs, Sternum.
- **In Pathological conditions** : liver and spleen and rarely lymph nodes.

ERYTHROPOIESIS

Stem cells / hemocytoblast



Large basophilic normoblast

small basophilic normoblast

Polychromatophilic erythroblast

Late non-dividing normoblast

Reticulocytes

Erythrocytes



ERYTHROPOIESIS

- Total time required for maturation of erythrocytes is 120 hours.
- Remains in circulation for 120 days.
- Normally 60 late normoblast are produced per 1000 of proerythroblast but during anemia production is reduced to 5- 6 cells per 1000 proerythroblast.

Leukopoiesis

- Granulocytes
Neutrophils, Eosinophils & Basophils
- Agranulocytes
Lymphocytes and Monocytes

Granulocytes are produced from bone marrow so they are called as Myelocyte cells.

Lymphocytes formed by the bone-marrow, & lymph nodes, while monocytes origin is not certain but mostly formed by spleen or lymph nodes.

Leukocytic promoting factor

Stem cells



matures into

Promyelocyte



Myelocyte

TLC & DLC

- TLC (5-9 thousand/ul)
- cattle 5-12 thousand/cumm
- Bitch 9-15 thousand/cumm
- N 3-5 thousand/ul - 60-70%
- L 1500-2000 in no. - 20-30%
- E 100-400 in no. - 2-4%
- M 100-800 in no. - 2-8%
- B 25-100 in no. - 0.5-2%

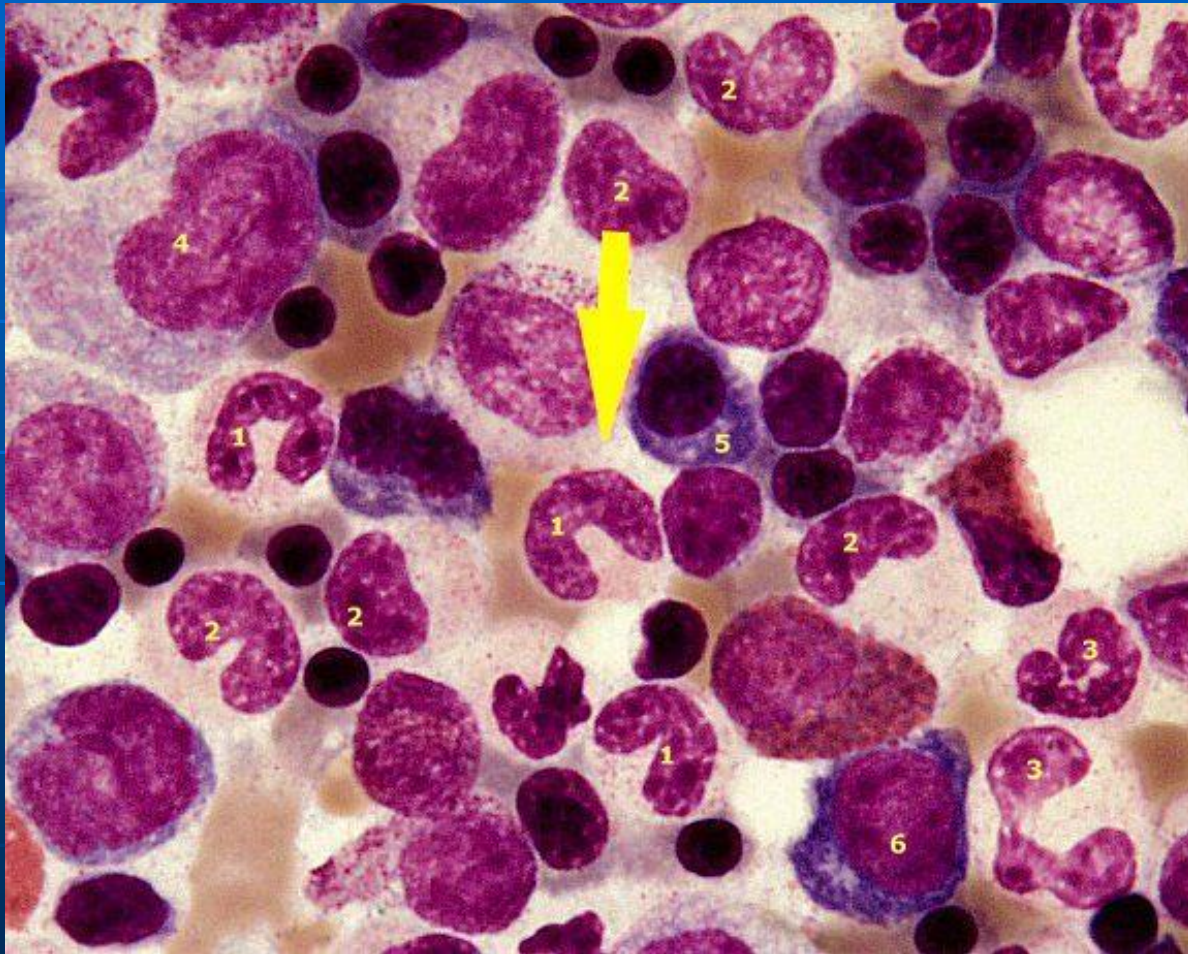
Sequestration

- Destruction of leukocytes by reticulo endothelial cells in lungs or lymph nodes.

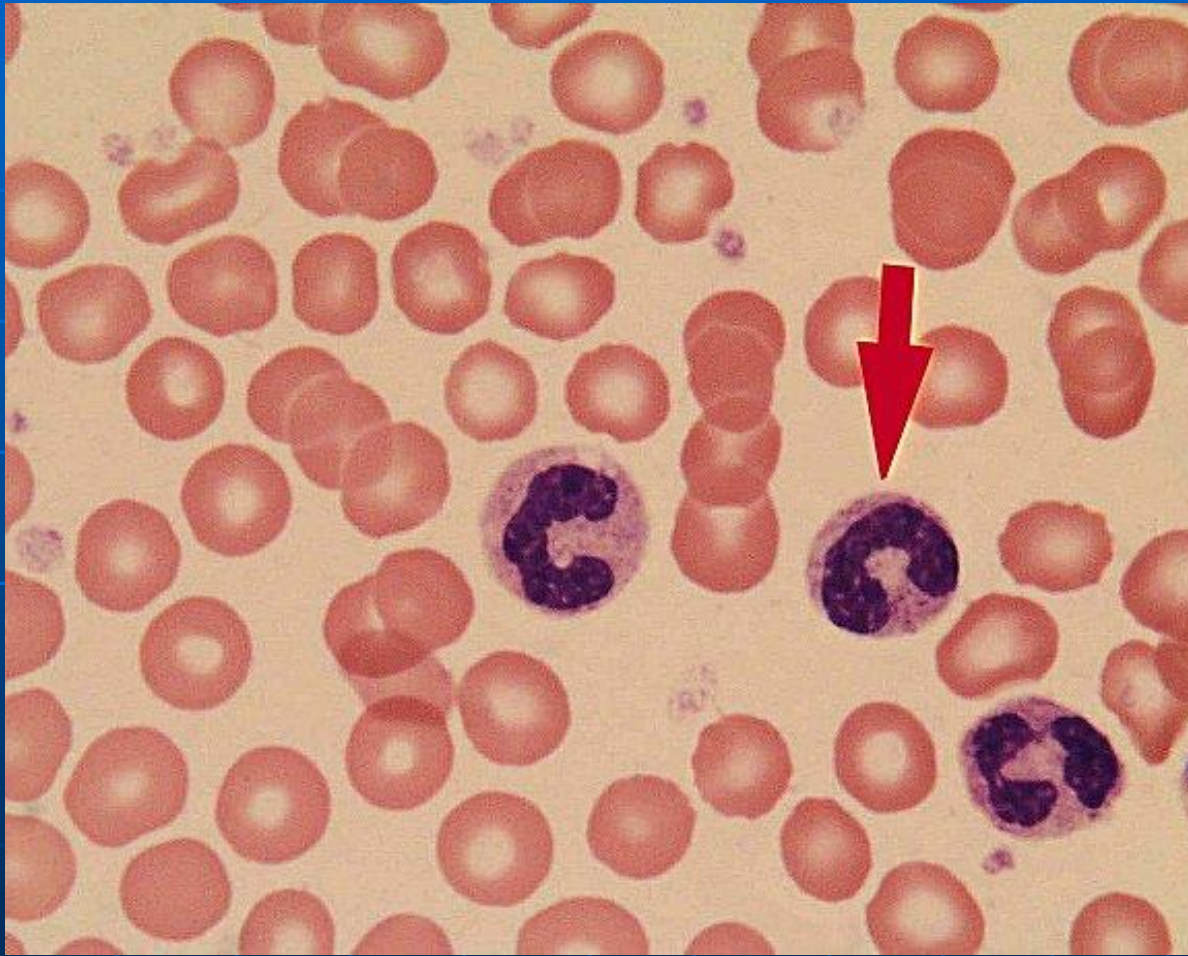
Neutrophils

- Neutrophils have bilobed, trilobed or tetralobed nuclei, so they are called as polymorphs. Cytoplasmic granules are very small in diameter, that is 0.02 to 0.5 μ . Diameter of neutrophils is 10-12 μ & they are amoeboid and phagocytic in character. Nucleus of each cell is divided into lobes or segments connected by filaments - called as segmented cells. Neutrophils have ascorbic acid, glutathione, Histamine and number of enzymes like lipase, Protease, catalase, phosphatase, Nucleotidase etc.
- In poultry Neutrophils are referred as heterophils, its large fusiform bodies that takes eosin stain.

Band Neutrophils

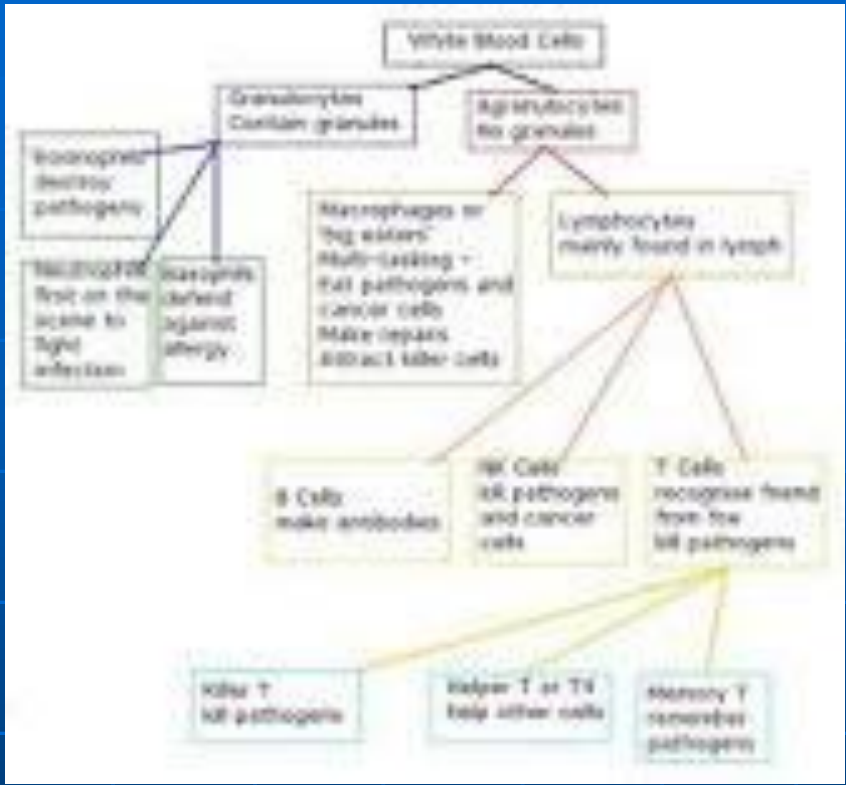


Band Neutrophils

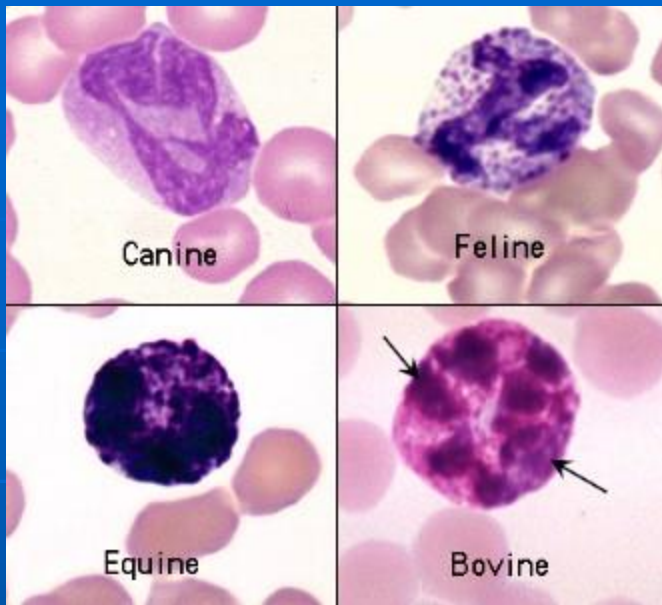


Eosinophils

- Cells with diameter of 10-12 μ .
- Cytoplasmic granules with diameter of 0.7 to 1.2 μ .
- Nuclei is less lobulated than those of neutrophils. motile and slightly phagocytic in nature. Eosinophilia - allergy, anaphylactic shock and parasitic infestation conditions.
- Eosinopaenia- stress related conditions, and due to ACTH inj. Epinephrine also causes eosinopaenia through ACTH release.



Basophils



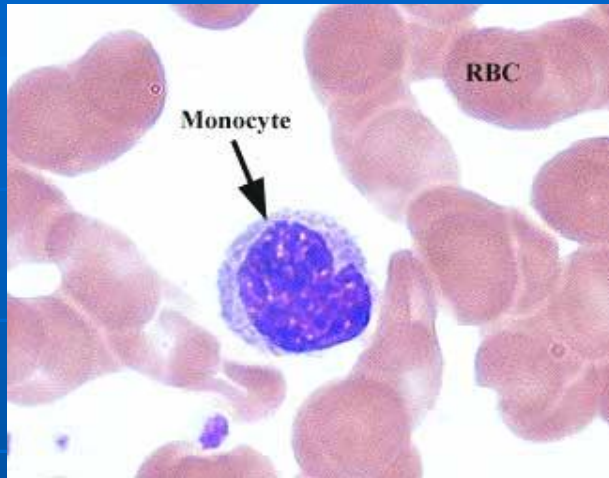
Water soluble cytoplasmic granules, which stains with alkaline dyes. Nuclei is bilobed. Diameter of basophils is 8-10 μ and cytoplasmic granules measures 0.5 to 1 μ in diameter. Phagocytic power is either very low or absent. It originates from basophilic myelocytes of the bone marrow.

Lymphocytes

- **Small lymphocytes** are 7 μ in diameter and have rounded compact nucleus, with very little cytoplasm around it. Life span is 2-3 days & produced by lymph nodes.
- **Large lymphocytes** are 10-12 μ in diameter. Nuclear material is not as compact as in small lymphocytes. Its' life span is 100-200 days and produced by thymus mainly.

- Physiological function of lymphocytes is phagocytosis, they engulf bacteria and removes infection from body. They also forms immunoblast, which is responsible for acceptance/rejection of grafted tissue in the body. Long life span of lymphocytes plays a major role in its production of immunoblast. Lymphopenia is due to stress or exogenous ACTH.

MONOCYTES



- characterised by presence of kidney/Horse Shoe shaped nucleus, produced by spleen and undergoing mitotic divisions, they matures into monocytes. Largest cells present in circulation, with diameter of 16-22 μ .
- They may have slight pinkish cytoplasmic granules, also known as histiocytes. Physiological function is phagocytosis they

THROMBOCYTES/PLATELETS

- Thrombocytes are smallest formed elements present in circulation. Formed from stem cells present in bone marrow and differentiates into megakaryoblast, measuring 20-40 μ . Before they emerges from sinusoids, they extend their Pseudopods, therefore pseudopods are nipped-off and released into circulation. These are small, colourless, round or rod shaped bodies circulating into blood. Average diameter is 3 μ . In chicken they are nucleated and size is relatively larger.
- **Life span of platelets is 8-11 days in circulation.** Average concentration of platelets is 2.5 to 5 lakhs/cubic mm. Their physiological function is that they helps in hemostasis by agglutination at injury site.