

Medical Biology

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Blood

Granulocytes:

❖ Neutrophils:

They constitute about 60-70% of the circulating leukocytes, their nucleus consists of 2-5 lobes (usually 3) linked together by fine chromatin thread. The cytoplasm of the neutrophils is filled with specific granules that are small.

These cells circulate in the blood in a resting state but with appropriate activation they leave the blood and enter the tissues where they become highly mobile, phagocytic cells and their primary function is to ingest and destroy the invading organisms. Once neutrophils perform their function of killing microorganisms they die, resulting in the formation of **pus**, the accumulation of dead WBC with bacteria and tissue fluid.



Neutrophilic granulocyte

❖ Eosinophils:

Are less numerous than neutrophils, they form only 2-4% of total WBC count. They have a characteristic bilobed nucleus. Their main feature is the presence of many large & elongated granules that are eosinophilic.

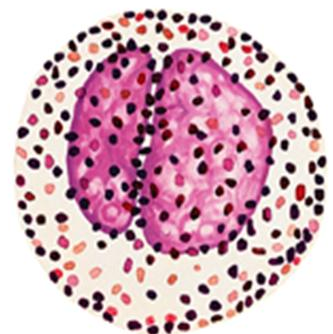
The number of eosinophils increase greatly in many types of parasitic infestations & the protection against the parasitic disease is one of their major functions. They also increase in allergic states.



Eosinophilic granulocyte

❖ Basophils:

Constitute less than 1% of the total WBC count, their nucleus is divided into irregular lobes, but this division is not so obvious and obscured by a cytoplasmic granule that are large and intensely basophilic, they are irregular in size & shape contain **histamine** (vasodilator) and **heparin** (anticoagulant). By migrating into connective tissues, basophils appear to transiently supplement the functions of mast cells. Like mast cells, basophils have surface receptors for immunoglobulin E (IgE) and secrete heparin and histamine in response to various antigens and allergens.



Basophilic granulocyte

Agranulocytes:

❖ Lymphocytes:

Lymphocytes make up 20-25% of WBCs. They are groups of spherical cells with similar morphological characters. They have an ovoid nucleus, the cytoplasm of the cell is scanty and can be seen as a thin rim around the nucleus. Major classes include B lymphocytes, helper and cytotoxic T lymphocytes (CD4+ and CD8+, respectively), and natural killer (NK) cells. These and other types of lymphocytes have diverse roles in immune defenses against invading microorganisms and certain parasites or abnormal cells.

The B cells produce antibodies that are used to attack invading bacteria, viruses, and toxins. The T cells destroy the body's own cells that have themselves been taken over by viruses or become cancerous.

Activation of B lymphocytes after an immune response to a foreign particle leads to their differentiation into plasma cells. Those cells are large cells with eccentric rounded nucleus, and they are responsible for active synthesis of immunoglobulins. Plasma cells are seen in a small population in lymphoid organs.



Lymphocyte

❖ Monocytes:

They are the largest of leukocytes. They constitute 3-8% of the white blood cells. They are spherical cells with oval or kidney shaped nucleus which are often placed eccentrically. Their cytoplasm is basophilic. Monocytes can live in the blood for 8 hours, after which they move into the connective tissue, where they may remain for a few months or longer. Blood monocytes are the precursor cells of tissue macrophages and other cells of the mononuclear phagocytic system such as kupffer cells in the liver, pulmonary and alveolar macrophages.



Monocyte



Monocyte

Clinical notes:

Increased numbers of white cells appear in the peripheral blood in a variety of disorders and provide a useful clue to underlying disease. For example:

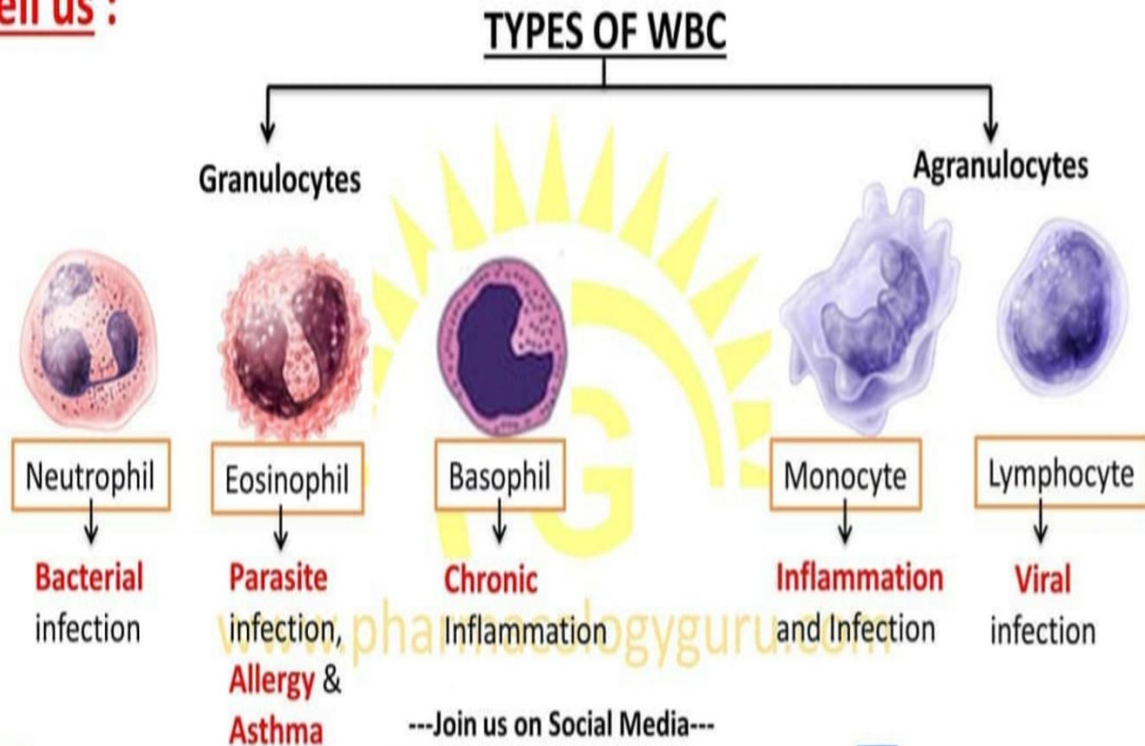
1. An increase in circulating neutrophils in bacterial infections (neutrophilia).
2. An increase in circulating eosinophil in parasitic infestations and some allergies and in asthma (eosinophilia).
3. An increase in circulating lymphocytes in certain viral infections (lymphocytosis).
4. An increase in circulating basophils indicates the presence of chronic inflammation.
5. Increase in monocyte levels indicates inflammation and infection.

Increase in differential WBC count,



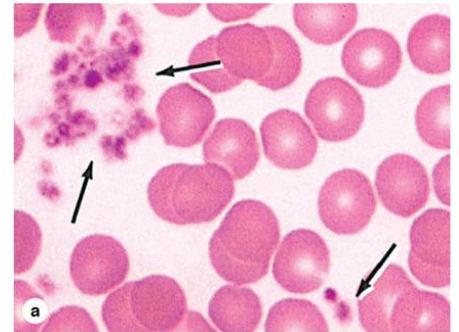
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Platelets (thrombocytes):

Are non-nucleated, small, disklike cells formed from fragmentation of a giant cell in the bone marrow called megakaryocytes. Platelets will promote blood clotting & help in repairing gaps in the wall of blood vessels. Their count is $150-400 \times 10^3/\text{mm}^3$. They have a life span of only 10 days. The role of platelets in controlling blood loss (hemorrhage) and in wound healing is as follows:



■ ■ **Primary aggregation:** Disruptions in the microvascular endothelium, which are very common, allow the platelet to form a **platelet plug** to stop bleeding.

■ ■ **Secondary aggregation:** Platelets in the plug increase the size of the plug.

■ ■ **Blood coagulation:** During platelet aggregation, **fibrinogen** from plasma, **von Willebrand factor** and other proteins released from the damaged endothelium, and platelet promote the sequential interaction (cascade) of plasma proteins, giving rise to a **fibrin** polymer that forms a three-dimensional network of fibers trapping RBCs and more platelets to form a **blood clot**, or **thrombus**.

■ ■ **Clot retraction:** The clot initially bulges into the blood vessel lumen, but soon contracts slightly.

■ ■ **Clot removal:** Protected by the clot, the endothelium and surrounding tunic are restored by new tissue, and the clot is then removed, mainly dissolved by the proteolytic

enzyme **plasmin**, which is formed continuously through the local action of **plasminogen activators** from the endothelium on **plasminogen** from plasma.

Disorders related to platelets:

There are lots of different groups of disorders affecting the platelets:

Thrombocythaemia – where there are too many platelets in circulation.

Thrombocytopenia – where there are too few platelets in circulation.

Dysfunction disorders – where there are the correct number of platelets in circulation, but they do not work properly.

All of these disorders mean that the clotting process is disrupted so lead to abnormal clot formation and bleeding.