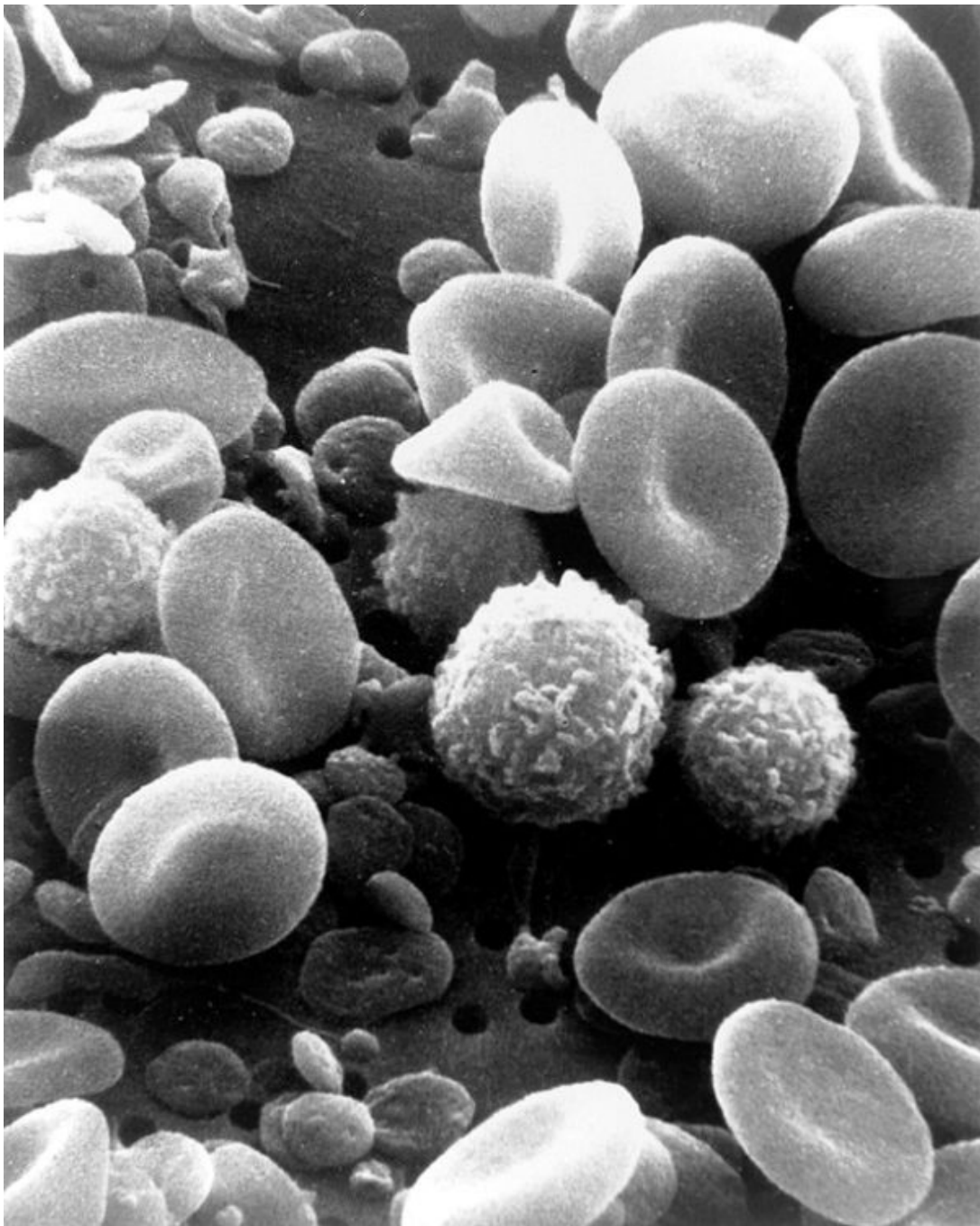


Quantitative White Blood Cell (WBC) Disorders — Types and Presentation

[See online here](#)

All blood cells originate from the bone marrow, from a maternal blood stem cell, which further differentiates into lymphoid stem cells predecessors of future white blood cells- lymphocytes (immune cells) and myeloid stem cells precursors of another two types of blood cells, namely red blood cells- erythrocytes and white blood cells- granulocytes (eosinophil, basophil, and neutrophil). Both types of white blood cells take part in the immune response to various infections, foreign bodies, and malignant neoplasms. Due to the miscellaneous external and internal influential factors, the ordered scheme of hemogenesis (production of all blood cells in the bone marrow) might be disturbed and the consequences of this disturbance manifest in different forms of blood diseases.



Definition and Background of Quantitative White Blood Cell (WBC) Disorders

The white blood cells (WBCs), also called leukocytes, are the army of our body. They provide surveillance and protect us from our micro-enemies (bacteria, viruses, and parasites). The normal white blood cells count ranges between 4,000 and 11,000 cells per microliter. When WBCs are less than 4,000 cells per microliter, the condition is called **leukopenia** (-penia meaning deficiency), and when they are more than 11,000 cells per microliter, it is called **leukocytosis**.

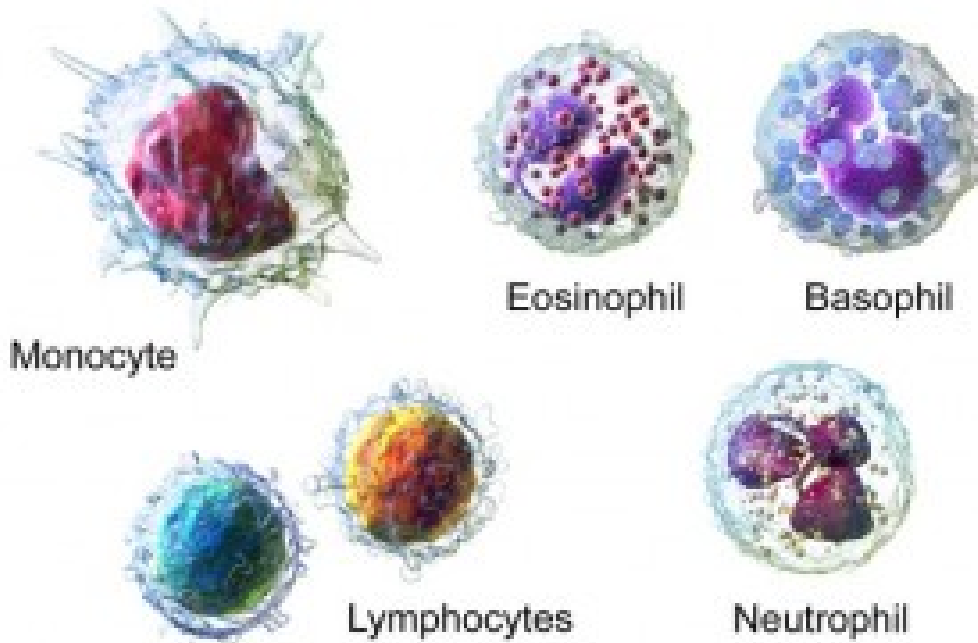
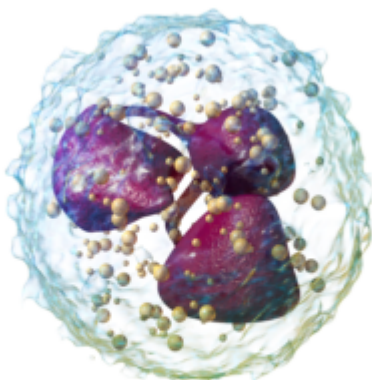


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Types of white blood cells

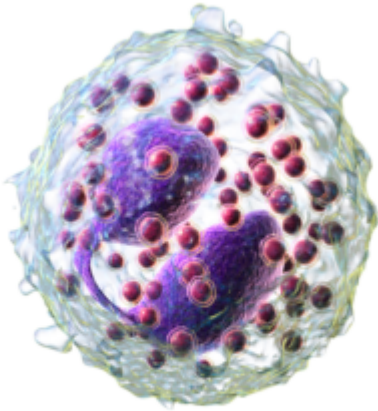
Neutrophils: They are the most common WBCs in our blood. They are so named because of the "neutral" staining properties of their cytoplasmic granules. The neutrophils have multilobed nucleus having 2-5 lobes. These cells counteract and digest bacteria and fungi, and are often the first-responders. They increase in acute inflammatory states.



Neutrophil

By BruceBlaus. When using this image in external sources, it can be cited as: Blausen.com staff (2014). "Medical gallery of Blausen Medical 2014". Wikijournal of Medicine 1 (2). DOI:10.15347/wjm/2014.010. ISSN 2002-4436. - Own Work, CC BY 3.0, <https://commons.wikimedia.org/w/index.php?curid=28223977>

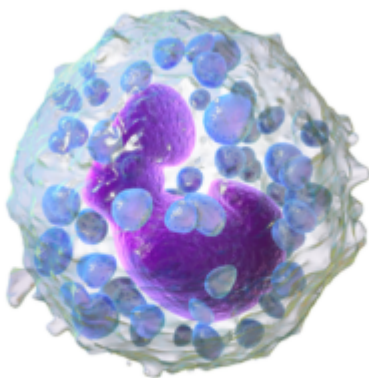
Eosinophils: The eosinophils are so named because their cytoplasmic granules stain bright red and take eosin on the hematoxylin and eosin (H&E) stain. These cells are involved in the killing of parasites and participate in allergic responses.



Eosinophil

By BruceBlaus. When using this image in external sources, it can be cited as: Blausen.com staff (2014). "Medical gallery of Blausen Medical 2014". Wikijournal of Medicine 1 (2). DOI:10.15347/wjm/2014.010. ISSN 2002-4436. - Own Work, CC BY 3.0, <https://commons.wikimedia.org/w/index.php?curid=28223973>

Basophils: The basophils are small cells and are hallmarks of **allergic reactions** in our body. They secrete **histamine** and other chemicals that produce symptoms of allergy, such as pruritis (itching). They control the body's immune response. They are so named because they stain dark blue on H&E staining.

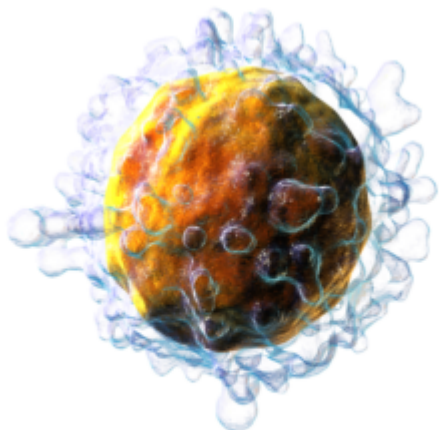


Basophil

By BruceBlaus. When using this image in external sources, it can be cited as: Blausen.com staff (2014). "Medical gallery of Blausen Medical 2014". Wikijournal of Medicine 1 (2). DOI:10.15347/wjm/2014.010. ISSN 2002-4436. - Own Work, CC BY 3.0, <https://commons.wikimedia.org/w/index.php?curid=28223968>

The term “Granulocytes” is used to collectively refer neutrophils, eosinophils, and basophils, as these cells contain multiple granules in their cytoplasm.

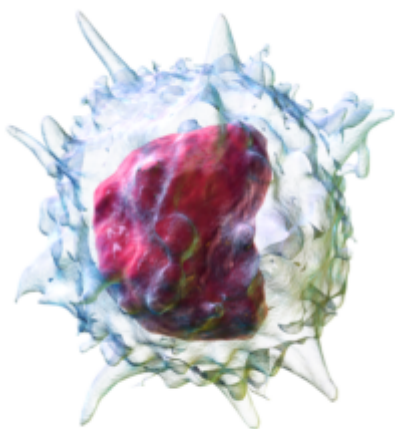
Lymphocytes: These cells contain large nucleus covering almost all the cell leaving a rim of cytoplasm behind. These cells are further broadly divided into B-cells, T-cells and natural killer cells, with the former type responsible for the production of antibodies that defend the body against various infections.



Lymphocyte
T cell

By BruceBlaus. When using this image in external sources, it can be cited as: Blausen.com staff (2014). “Medical gallery of Blausen Medical 2014”. Wikijournal of Medicine 1 (2). DOI:10.15347/wjm/2014.010. ISSN 2002-4436. – Own Work, CC BY 3.0, <https://commons.wikimedia.org/w/index.php?curid=28761827>

Monocytes: These white blood cells possess the longest lifespan amongst other white blood cells; they become macrophages within the tissues. Their nucleus is bean-shaped.



Monocyte

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Normal blood count of leukocytes

- Neutrophils - 2000-7000/microliter (40 - 75%)
- Lymphocytes - 1000-3000/microliter (20 - 40%)
- Monocytes - 200-1000/microliter (2 - 10%)
- Eosinophils - 20-500/microliter (1 - 6%)
- Basophils - 20-100/microliter (<1 - 2%)

This can be remembered by the mnemonic “**N**ever **L**et **M**onkeys **E**at **B**ananas,” with the neutrophils being the most common WBC, followed by lymphocytes, monocytes, eosinophils, and the basophils.

Etiology of Quantitative White Blood Cell (WBC) Disorders

The etiological reasons for high white blood count (Leukocytosis)

- Infections
- Acute leukemia (ALL and AML)
- Chronic leukemia (CLL and CML)
- Severe allergic reactions
- Corticosteroids and epinephrine therapy
- Smoking and alcohol abuse
- Polycythemia vera
- Emotional or physical stress

The etiology of low white blood cells count (Leukopenia)

- Viral infections (disrupting bone marrow stem cell production)
- Chemotherapy (immunosuppressive effect)
- Radiation therapy
- Drug effects (e.g. antibiotics such as trimethoprim-sulfamethoxazole, chloramphenicol)
- Congenital diseases impairing bone marrow function (e.g. Kostmann’s syndrome)
- Hypersplenism
- Aplastic anemia
- Autoimmune diseases (lupus and rheumatoid arthritis and other autoimmune disorders)
- Malnutrition and vitamin deficiencies

Presentation of Quantitative White Blood Cell

(WBC) Disorders

Neutropenia

Neutropenia is defined as the deficiency of circulating neutrophils. When the absolute neutrophil count (ANC) ≤ 1500 cells/microliter then it is labeled as neutropenia. It is divided into mild, moderate and severe neutropenia depending upon the ANC.

- **Mild neutropenia:** It is present when the ANC is 1000-1500 cells/ μ L.
- **Moderate neutropenia:** It is present when the ANC is 500-1000/ μ L.
- **Severe neutropenia:** It is present when the ANC is less than 500 cells/ μ L.

The neutropenia is always associated with severe infections, as the body loses its ability to protect against the pathogenic agents. This condition usually manifests with these symptoms:

- Fever
- Sore mouth (oral mucosa is always affected manifesting in gingival pain and swelling)
- Dysphagia
- Skin abscesses (impetigo)
- Otorhinolaryngeal infections (recurrent sinusitis and otitis)
- Respiratory infection (a cough, breathlessness)

The risk of infection in neutropenic patients is directly related to both the severity and duration of the neutropenia.

Agranulocytosis

The term agranulocytosis refers to a virtual absence of circulating neutrophils. This term is often applied when the ANC is $<100/\mu$ L; hence, the "agranulocytosis" is used to describe more severe neutropenia. The agranulocytosis is associated with recurrent infections and may manifest with the following symptoms:

- Severe malaise
- High-grade fever, possibly with chills and confusion
- Painful stomatitis (bleeding and friable mucosa)
- Pharyngitis, with difficulty in swallowing

Neutrophilia

The neutrophilia is defined as an increased number of circulating neutrophils. This condition is often associated with **acute** inflammatory states such as bacterial infections, trauma, stroke and myocardial infarctions, or it may be a consequence of a shift of cells from the marginal to the circulating pool (shift neutrophilia) in response to certain events (e.g. corticosteroid use).

Shift neutrophilia is a transient condition that lasts for 20 – 30 minutes due to various reasons, such as excessive physical loads, seizures, paroxysmal tachycardia attacks, epinephrine or corticosteroid use. The quantitative properties do not change, as the inflow of the cells remains the same.

True neutrophilia occurs due to acute inflammatory states such as bacterial infections. When the utilization of neutrophils increases, the bone marrow cell production intensifies,

showing numerous immature forms of neutrophils stipulating left shift in the complete blood counts.

Lymphopenia

This white blood cells disorder is associated with a decreased number of lymphocytes. It usually occurs due to:

- Severe viral infections such as dengue fever (suppressing the bone marrow function)
- Myelodysplastic syndrome
- HIV/AIDS
- Chemotherapy

Lymphocytosis

The lymphocytosis means an increased number of circulating lymphocytes. The lymphocytes play an important part in viral infections and chronic inflammatory states, including chronic infections. Hence lymphocytosis is seen in:

- Acute viral infections (e.g. infectious mononucleosis, CMV, measles, mumps infections)
- Some bacterial infections (e.g. pertussis)
- Chronic bacterial infections (e.g. tuberculosis, brucellosis)
- Acute lymphoblastic leukemia
- Chronic lymphocytic leukemia
- Lymphoma

Monocytosis

Monocytosis is defined as an increased number of circulating monocytes. The monocytes are often increased in chronic inflammatory conditions, similar to the lymphocytes. These conditions are:

- Chronic Infections (e.g. tuberculosis, brucellosis, subacute infective endocarditis)
- Cancers such as Hodgkin's lymphoma and leukemia
- Autoimmune diseases such as SLE and rheumatic arthritis
- The recovery phase of acute infection
- Sarcoidosis

Eosinophilia

Eosinophilia means an increased number of circulating eosinophils. This condition may occur in the following settings:

- Parasitic and fungal diseases (e.g. ascariasis, trichinosis, aspergillosis)
- Allergies (asthma, eczema)
- Autoimmune diseases
- Churg-Strauss syndrome
- Drug allergies
- Eosinophilic leukemia
- Hypereosinophilic syndrome

Basophilia

Basophilia means an increased number of circulating basophils. The isolated basophilia is a very uncommon condition and may be seen in **myeloproliferative disorders** such as chronic myelogenous leukemia (CML).

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Notes