Know your WBCs

Connie Cole
Indiana University - Purdue University Fort Wayne, colecs@ipfw.edu

Connie Herron
IPFW

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Know your WBCs

By Connie Herron, MS, RN-BC, NP-C, MDI
Lecturer • Indiana University—Purdue University • Fort Wayne, Ind.

The measurement of the total and differential white blood cell (WBC) count is a commonly performed diagnostic test. It can provide crucial information about your patient’s status, especially if infection, allergy, immunosuppression, or neoplasm is being considered.

The cells
Leukocytes, or WBCs, originate from the red bone marrow found in flat and irregular bones, ribs, vertebrae, the sternum, and the pelvis. All blood cells develop from a single stem cell in a process called hematopoiesis (see Picturing hematopoiesis). The differentiation process forms cells into each type of blood cell: red cells, white cells, and platelets.

WBCs make up only about 1% of the blood volume. Five types of WBCs develop and differentiate from the original stem cell. Their major function is to fight infection, but each has defining characteristics that make them unique.

• **Neutrophils** (also called polys, segs, or polymorphonuclear leukocytes) are the most common, making up about 50% to 60% of the total WBCs. Neutrophils are the first to respond to any tissue damage. Their job is to phagocytize bacteria, but they live only 4 days. An immature neutrophil is called a band; bands are increased in number by bacterial infection (referred to by many clinicians as a “left shift”).
• **Lymphocytes** make up 30% to 40% of the total WBCs. Lymphocytes are the primary cells of immune response and include the T cells and B cells. The primary function of lymphocytes is to fight chronic bacterial infection and acute viral infections (see In the trenches).
• **Monocytes** make up 6% of the total WBCs. They leave the bloodstream and enter tissue to become macrophages, cleaning up tissue damage that has occurred.
• **Eosinophils** make up 3% of the total WBCs and are active in response to histamine. They’re often increased by allergic reactions (asthma) and parasitic infections.
• **Basophils** make up 1% of the total WBCs and are the least understood. They appear to leave the blood and enter tissue to become mast cells capable of releasing histamine and heparin (see On the front line).

The count
When a complete blood cell (CBC) count is ordered and drawn, lab personnel determine the number of leukocytes present in 1 mm³ of venous blood. Other indexes related to red cells and platelets are also measured but not discussed here. Adding a differential count (CBC with differential) to the panel provides the clinician with more specific diagnostic data, including the number, variety, and concentration of each type of leukocyte.

The differential measures the percentage of each type of leukocyte present in the same specimen, adding up to 100% (see Normal WBC count values). An increase in one type of WBC always means a decrease in a different type of WBC. The absolute count (the actual number of each WBC type) isn’t generally reported on lab results but can be easily calculated by multiplying the percentage by the WBC count. For example:

Memory Jogger
To remember the different types of leukocytes in their descending proportion in a blood specimen, use this mnemonic:

- Never (neutrophils): 60%
- Let (lymphocytes): 30%
- Monkeys (monocytes): 6%
- Eat (eosinophils): 3%
- Bananas (basophils): 1%.
WBC total of 10,000 \times \text{neutrophil differential percentage of 0.60} = 6,000 neutrophils.

The normal number of total leukocytes varies, but many diseases cause increased or decreased numbers. Leukocytosis, an increased WBC count, usually indicates infection, inflammation, leukemia, or tissue necrosis. In some infections, such as sepsis, the WBC count may reach extremely high levels. Leukopenia, a WBC count of less than 4,000, usually indicates bone marrow failure, such as seen in chemotherapy, radiation therapy, and sometimes overwhelming infection. When your patient’s WBC count goes below normal, he or she is more at risk for infection. Precautions for immunosuppression may be needed for a WBC count of less than 2,000.

**Abnormal differential findings**

Abnormal test results may offer clinical significance and include the following:
- **Neutrophilia**, an increased neutrophil count, is often associated with bacterial infection, inflammation, malignancy, physical or emotional stress, and metabolic

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**Picturing hematopoiesis**

1. Multipotential stem cells in bone marrow give rise to...
2. ...five distinct types of unipotential stem cells.
3. Unipotential stem cells differentiate into the various types of blood cells.
deciphering diagnostics

In the trenches

Agranulocytes, with “platoons” of lymphocytes and monocytes, may roam freely on “patrol” when inflammation is reported, but they mainly “dig in” at structures that filter large amounts of fluid (such as the liver) and defend against invaders.

Lymphocytes eat the enemy, or produce antibodies.

Monocytes eat bacteria, cellular debris, and necrotic tissue.

disorders. Extremely high counts may indicate leukemia.

- **Neutropenia**, a decreased neutrophil count, can be seen as a response to radiation therapy, chemotherapy, viral infection, or a prolonged infection with which the body can no longer keep up. Sometimes this occurs in response to medications (such as nonsteroidal anti-inflammatory drugs, vancomycin, phenytoin, and furosemide). You should calculate your patient’s absolute neutrophil count and consider protective isolation if the count is less than 1,000.

- **Bandemia**, an increase in the number of immature neutrophils released into circulation, can occur with severe bacterial infections. The neutrophils are released in immature form (bands) as the mature neutrophils become used up. (This has often been referred to as a left shift, a term that comes from the fact that immature cell counts were on the left counters when lab technicians would perform counts by hand.)

- **Lymphocytosis**, an increased number of lymphocytes, occurs with chronic bacterial infections, viral infections (such as mumps and mononucleosis), leukemia, rheumatoid arthritis, multiple myeloma, and hepatitis.

- **Lymphocytopenia**, a decreased number of lymphocytes, occurs with leukemia, sepsis, lupus erythematosus, radiation therapy, and immunodeficiency diseases such as HIV. Adrenocorticosteroids and antineoplastic drugs can also cause lymphocytopenia.

- **Monocytosis**, an increase in the number of monocytes, can be found with chronic inflammatory disorders (such as ulcerative colitis), infectious mononucleosis, and tuberculosis.

- **Monocytopenia**, a decreased number of monocytes, can be a response to prednisone therapy or may be caused by aplastic anemia or leukemia.

- **Eosinophilia**, an increase in the total eosinophil count, is usually related to parasitic infections, allergic reactions, asthma, eczema, autoimmune diseases, or leukemia.

- **Eosinopenia**, a decrease in the total eosinophil count, can be related to increased adrenocortical production.

- **Basophilia**, an increased number of basophils, can be related to myeloproliferative disorders such as polycythemia vera or leukemia.

**Normal WBC count**

<table>
<thead>
<tr>
<th>Cell type</th>
<th>Differential (%)</th>
<th>Absolute number (mm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total WBC count</td>
<td>100</td>
<td>5,000 to 10,000</td>
</tr>
<tr>
<td>Neutrophils</td>
<td>55 to 70</td>
<td>2,500 to 8,000</td>
</tr>
<tr>
<td>Lymphocytes</td>
<td>20 to 40</td>
<td>1,000 to 4,000</td>
</tr>
<tr>
<td>Monocytes</td>
<td>2 to 8</td>
<td>100 to 700</td>
</tr>
<tr>
<td>Eosinophils</td>
<td>1 to 4</td>
<td>50 to 500</td>
</tr>
<tr>
<td>Basophils</td>
<td>0.5 to 1.0</td>
<td>25 to 100</td>
</tr>
</tbody>
</table>
• **Basopenia**, a decreased number of basophils, can be related to acute allergic reactions, hyperthyroidism, or stress.

**A powerful combination**
As a nurse, you play an integral role in the diagnosis and management of your patient's disease states. Understanding the information provided by the WBC indexes, especially when correlated with your patient's condition, provides valuable information about your patient's status and response to treatment.

**Learn more about it**

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**On the front line**

Granulocytes, with “platoons” of basophils, neutrophils, and eosinophils, are the first forces “marshaled” against invading foreign organisms.

- **Basophils** spit histamine at inflammatory and immune stimuli.
- **Neutrophils** eat foreign bodies.
- **Eosinophils** eat antigens and antibodies.

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