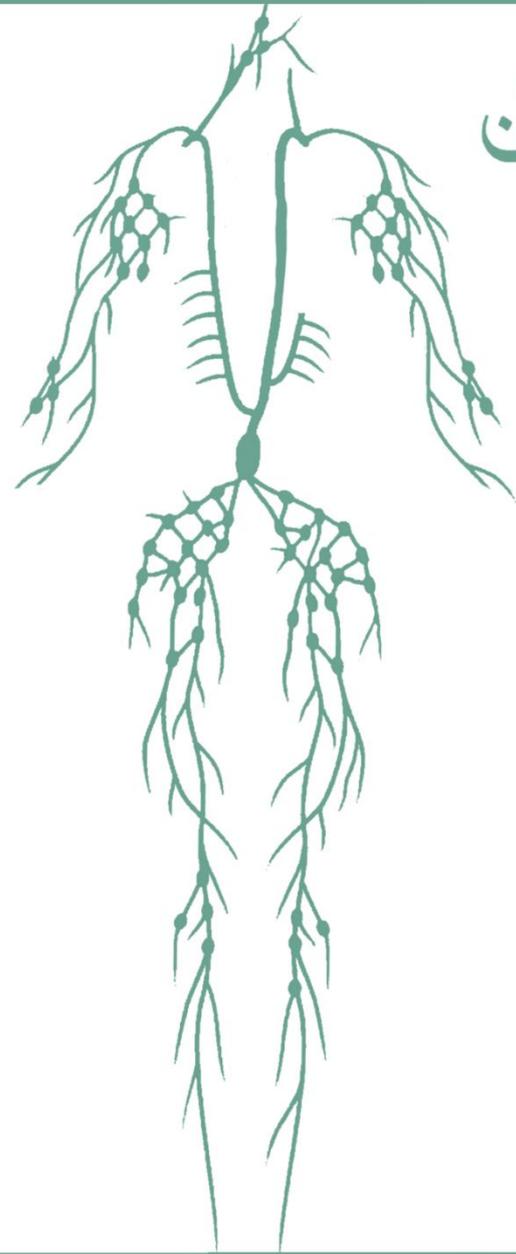
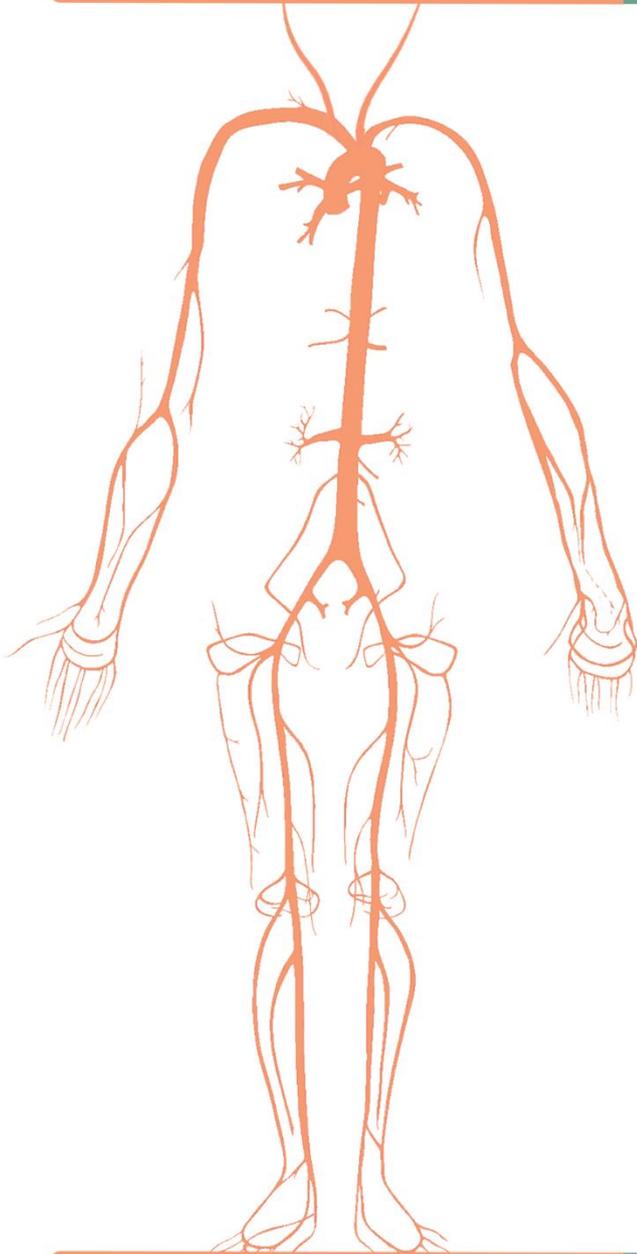


Physiology HematoLymphatic



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Title: Sheet 8 – Leukocytes

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The table below shows the factors that are involved in leukopoiesis. Note that each factor can stimulate many cell lines, and some of these factors are produced from more than one source.

TABLE 3-1 Hematopoietic growth factors.

| Cytokine | Cell Lines Stimulated | Cytokine Source |
|----------------|---|---|
| IL-1 | Erythrocyte Granulocyte Megakaryocyte Monocyte | Multiple cell types |
| IL-3 | Erythrocyte Granulocyte Megakaryocyte Monocyte | T lymphocytes |
| IL-4 | Basophil | T lymphocytes |
| IL-5 | Eosinophil | T lymphocytes |
| IL-6 | Erythrocyte Granulocyte Megakaryocyte Monocyte | Endothelial cells, fibroblasts, macrophages |
| IL-11 | Erythrocyte Granulocyte Megakaryocyte | Fibroblasts, osteoblasts |
| Erythropoietin | Erythrocyte | Kidney Kupffer cells of liver |
| SCF | Erythrocyte Granulocyte Megakaryocyte Monocyte | Multiple cell types |
| G-CSF | Granulocyte | Endothelial cells, fibroblasts, monocytes |
| GM-CSF | Erythrocyte Granulocyte Megakaryocyte | Endothelial cells, fibroblasts, monocytes, T lymphocytes |
| M-CSF | Monocyte | Endothelial cells, fibroblasts, monocytes, |
| Thrombopoietin | Megakaryocyte | Liver, kidney |

CSF, colony-stimulating factor; G, granulocyte; IL, interleukin; M, macrophage; SCF, stem cell factor.

- ❁ Although each type of leukocytes has specific characteristics, all leukocytes possess - to some degree- four basic properties that relate to their functions in the body:
 - 1) **Diapedesis:** they are able to pass through the walls of capillaries; to enter the tissue spaces in accordance with the local needs.
 - 2) Leukocyte motility or crawling: once within the tissue spaces, the leukocytes (particularly neutrophils) have the ability to move through the tissues by an **ameboid motion**.
 - 3) **Chemotaxis:** they are attracted by certain chemical substances released by bacteria or by inflamed tissues, and repelled from the intact area.
 - 4) **Phagocytosis:** the ability to engulf and digest or kill bacteria, as well as products of the dead cells.

The first line of defense (innate immunity) includes certain types of WBCs; therefore all of them are increased in infections and inflammation, but with varying degrees. The table below illustrates the indications of high and low count of each type of leukocytes.

| WBC type | High count could indicate | Low count could indicate |
|-------------|--|--|
| Neutrophils | Bacterial infections, burns, stress, and inflammation. (mainly; infections) Extra: high plasma cortisol (the primary stress hormone) levels increases neutrophil counts. | Radiation exposure, drug toxicity, vitamin B12 deficiency, and systemic lupus erythematosus (SLE). |
| Lymphocytes | Viral infections and leukemia. | Prolonged illness, immunosuppression, and treatment with cortisol . |
| Monocytes | Viral or fungal infections, tuberculosis, leukemia, and other chronic diseases. | Bone marrow suppression and treatment with cortisol . |
| Eosinophils | Allergic reactions, parasitic infections, and autoimmune diseases. | Drug toxicity and stress . |
| Basophils | Allergic reactions, leukemia (extra: specifically, CML), cancers, and hypothyroidism . | Pregnancy, ovulation, stress , and hyperthyroidism . |

- ✓ Usually, when the cause of leukocytosis is eliminated, the count returns to normal level. But sometimes in diseases and abnormal functions, the leukocyte count increases and doesn't return back to normal, resulting in **leukemia**.

Leukemia: uncontrolled production of WBCs (liquid tumors), greatly increasing the number of WBCs in the circulation.

🌸 Causes of leukemia:

Not all causes of leukemia are known, however, some of the known causes are:

- 1) Radiations: such as in Japan (*Hiroshima* and *Nagasaki*).
- 2) Some chemicals.
- 3) Viruses.
- 4) Environmental factors.
- 5) Genetic factors.

🌸 Leukemia occurs in two forms:

- 1) **Acute leukemia:** occurs suddenly with symptoms similar to cold, bone pain, paleness, tendency to bleed, and frequent infections. It's common in children.

2) **Chronic leukemia:** the most common form of the disease in adults (usually >40 years). It comes slowly without warning. Many cases are discovered during routine check or after changes in blood are noticed. It may persist for several years without significant symptoms.

🌸 **Types of leukemia depending on the location:**

- 1) Lymphocytic leukemia: in the lymphoid tissue.
- 2) Myelocytic leukemia: in the bone marrow.

🌸 **Leukemia cells morphology:**

- ✓ The leukemia cells are bizarre, undifferentiated and not identical with any of the normal WBCs.
- ✓ Usually the more **undifferentiated** the cells, the more **acute** is the leukemia.
- ✓ If the neoplastic (proliferating) cells are mature (somewhat differentiated) cells, the leukemia is usually **chronic**, sometimes developing slowly over 10 to 20 years.
- ✓ Leukemia cells, especially the undifferentiated cells, are usually **nonfunctional**.

🌸 **Effects of leukemia on the body:**

- 1) The first effect of leukemia is metastatic growth of leukemia cells in abnormal areas of the body.
- 2) The leukemia cells of the **bone marrow** invade the surrounding **bone**.
- 3) Almost all leukemias spread to the **spleen, lymph nodes, liver** and **vascular** regions.
- 4) In each of these areas the rapidly growing cells invade the surrounding tissues, utilizing the metabolic elements of these tissues, thus causing tissue destruction.
- 5) Very common effects in leukemia are the development of infections, severe anemia and bleeding tendency (caused by thrombocytopenia (low platelet counts)).
- 6) The most important effect of leukemia on the body is **the excessive use of metabolic substrates by the growing cancerous cells**.
- 7) Heavy demands are made on the body for foodstuffs, especially the **amino acids** and **vitamins**. Consequently, the energy of the patient is greatly depleted, and rapid deterioration of the normal protein tissues of the body occurs.
- 8) Obviously, after metabolic starvation had continued long enough, this alone is sufficient to cause death.

Good Luck!!