Physiology of Blood

Lec. 2

Resistance of the Body to Infection

• Our bodies are exposed continually to bacteria, viruses, fungi, and parasites, all of which occur normally and to varying degrees in the skin, the mouth, the respiratory passageways, the intestinal tract, the lining membranes of the eyes, and even the urinary tract. Many of these infectious agents are capable of causing serious abnormal physiologic function or even death if they invade the deeper tissues. In addition, we are exposed intermittently to other highly infectious bacteria and viruses besides those that are normally present, and these can cause acute lethal diseases such as pneumonia, streptococcal infection, and typhoid fever.

- Our bodies have a special system for combating the different infectious and toxic agents. This is comprised of blood leukocytes (white blood cells) and tissue cells derived from leukocytes. These cells work together in two ways to prevent disease:
- (1) by actually destroying invading bacteria or viruses by phagocytosis
- (2) by forming antibodies and sensitized lymphocytes, one or both of which may destroy or inactivate the invader.

White blood cells

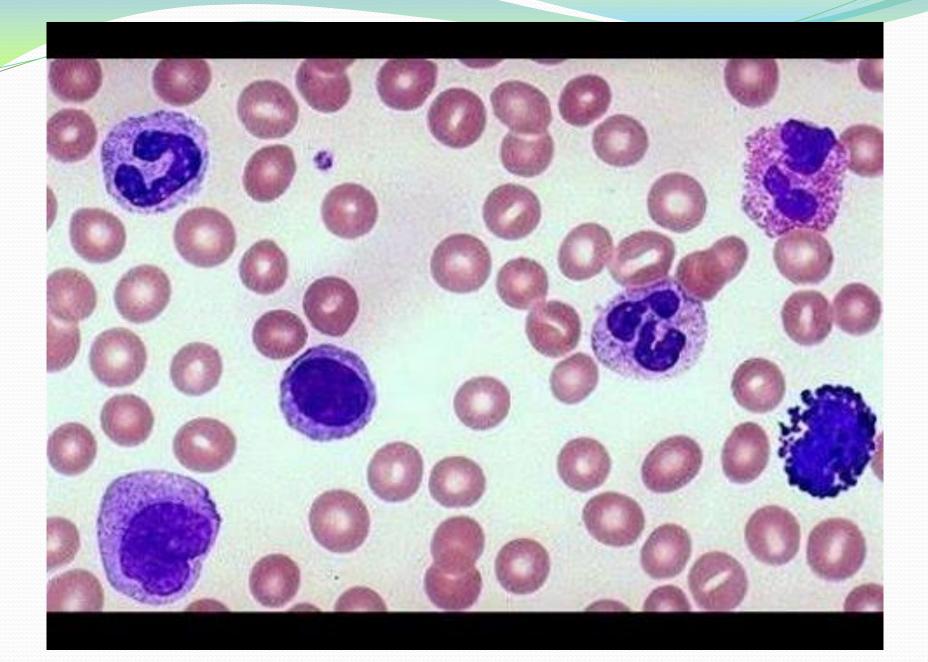
- The W.B.C. count is from (4000-11000) cells per cubic millimeter, if the count is less than 4,000, the condition is called leucopenia, if it's more than 11,000, the condition is leukocytosis.
- W.B.C are involved in the body defense mechanism against micro-organism and other foreign materials.
- W.B.C are classified according to the type of cytoplasm into the following:

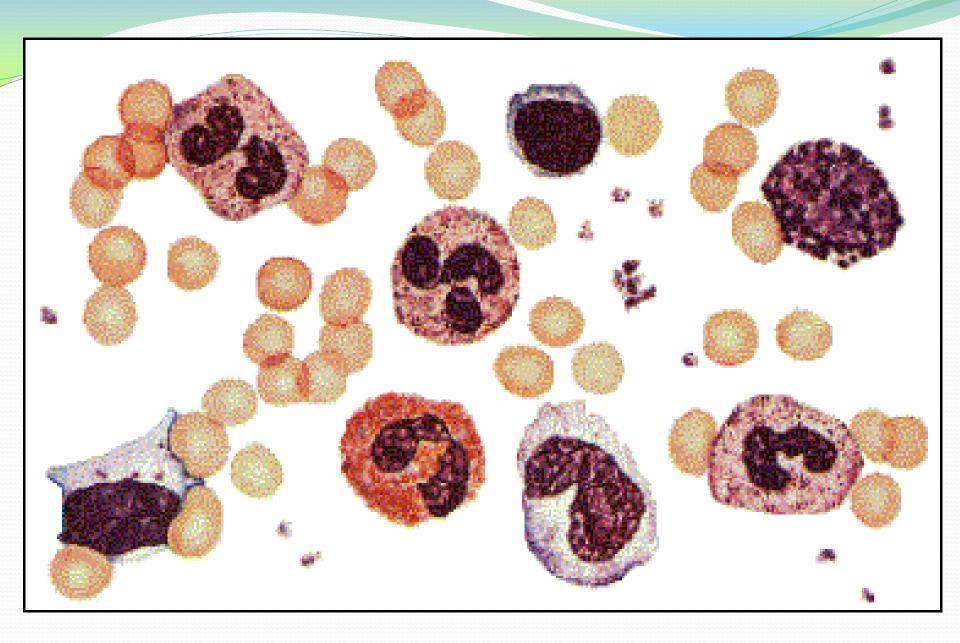
• 1. Granular leukocytes:

- In which the cytoplasm contains granules, these are classified into polymorphonuclear leukocytes which include:
- a)Neutrophils:Multilobed nucleus, 2-5 lobes depending on the age of the cell. The percentage is 50-70%.
- b) Eosinophils: Multilobed nucleus "usually bilobed". The percentage is 1-4%.
- c) Basophils: In this type the nucleus takes the (S) shape. The percentage is 0.4%

• 2. Agranular leukocytes:

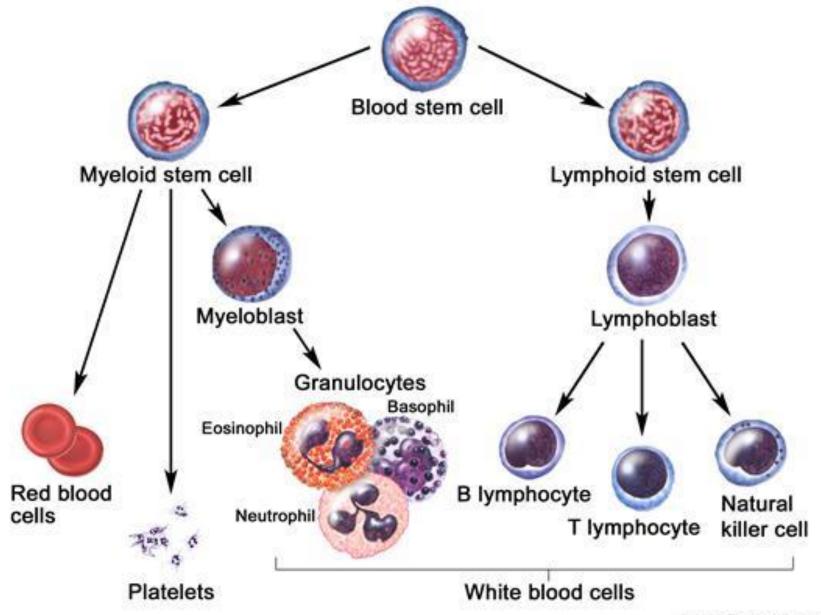
- In which there are no granules in the cytoplasm, these are classified into:
- a) Monocytes: the nucleus is kidney shaped and they are the largest cell in the body. The percentage is 2-8%.
- b)Lymphocytes: They are large lymphocytes and small lymphocytes which depend on the age, the percentage is 20-40%.
- The granulocytes and monocytes protect the body against invading organisms mainly by ingesting them, that is by phagocytosis. The lymphocytes and plasma cell function mainly in connection with immune system.





Genesis of leukocytes:

- The granulocytes and monocytes are formed only in the bone marrow.
- Lymphocytes and plasma cells are produced mainly in the various lymphogenesis organs, including the lymph gland, spleen, thymus.....etc.



Genesis of Myelocytes 13 15 16 12 10

Genesis of Lymphocytes

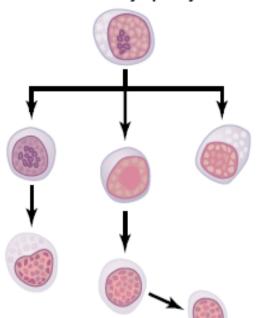


Figure 33-1

Genesis of white blood cells. The different cells of the myelocyte series are 1, myeloblast; 2 promyelocyte; 3, megakaryocyte 4, neutrophil myelocyte; 5, young neutrophil metamyelocyte; 6 "band" neutrophil metamyelocyte 7, polymorphonuclear neutrophil 8, eosinophil myelocyte; 9 eosinophil metamyelocyte; 10 polymorphonuclear eosinophil 11, basophil myelocyte; 12, polymorphonuclear basophil; 13–16 stages of monocyte formation.

• Life spam of the W.B.C.:

- The main reason that W.B.C.s are present in the blood is to be transported from the bone marrow or lymphoid tissue to the areas of the body where they needed.
- The life of the granulocytes, once released from the bone marrow is normally 4-8 hours, circulating in the blood and another 4-5 days in the tissues. In times of serious tissue infection, this total life spam is often only a few hours, because the granulocytes proceed rapidly to the infected area.

- The monocytes also have a short time, 10-20 hours, in the blood before wandering through the capillary membrane into the tissue. They can live for months or even years unless they are destroyed by performing phagocytic function.
- The lymphocytes have life spam of weeks, months or even years, but this depends on the body's need for these cells.
- Our bodies have a special system for combating the different infections and toxic agents. this is composed of W.B.C.s, and tissue cells. These cells all work together to prevent diseases by actually destroying invading agents by phagocytosis and by forming antibodies and sensitized lymphocytes.

• Phagocytosis:

- The most important function of the neutrophils and macrophages is phagocytosis which means cellular ingestion of the offending agent.
- Phagocytes must be selective of the material that is phagocytized, otherwise, some of the normal cells and structures of the body would be ingested. Whether or not phagocytosis will occur depends especially on three selective procedures:

- Most natural structures in tissue have smooth surface, which resist phagocytosis. But if the surface is rough, the likelihood of phagocytosis is increased.
- 2. Most natural substances of the body have protective protein coats that they repel the phagocytes, on the other hand, dead tissues and most foreign particles frequently have no protective coats, which also make the subject to phagocytosis.
- 3. The body has a specific means of recognizing certain foreign materials.
- The immune system develops antibodies against infections agents like bacteria. The antibodies that adhere to the bacterial membrane by making the bacteria especially susceptible to phagocytosis.

• Inflammation:

- When tissue injury occurs, whether caused by bacteria, trauma, chemicals, heat or any other phenomenon, multiple substances that cause dramatic secondary changes in the tissues are released by the injured tissues. The entire complex of tissue changes is called inflammation.
- Inflammation is characterized by:

- 1. Vasodilation of the local vessels.
- 2. Increased permeability of the capillaries.
- 3. Often clotting of the fluid in the interstitial spaces because of the excessive amounts of fibrinogen and other protein leaking from the capillaries.
- 4. Migration of large numbers of granulocytes and monocytes in the tissue.
- 5. Swelling of the tissue cells.

• Neutrophilia. :

• Acute Increase in Number of Neutrophils in the Blood occurs within a few hours after the onset of acute, severe inflammation, the number of neutrophils in the blood sometimes increases fourfold to fivefold—from a normal of 4000 to 5000 to 15,000 to 25,000 neutrophils per microliter.

This is called neutrophilia, which means an increase in the number of neutrophils in the blood. Neutrophilia is caused by products of inflammation that enter the blood stream, are transported to the bone marrow, and there act on the stored neutrophils of the marrow to mobilize these into the circulating blood. This makes even more neutrophils available to the inflamed tissue area.

Formation of Pus:

- When neutrophils and macrophages engulf large numbers of bacteria and necrotic tissue, essentially all the neutrophils and many, if not most, of the macrophages eventually die. After several days, a cavity is often excavated in the inflamed tissues that contains varying portions of necrotic tissue, dead neutrophils, dead macrophages, and tissue fluid.
- This mixture is commonly known as pus.

• After the infection has been suppressed, the dead cells and necrotic tissue in the pus gradually autolyze over a period of days, and the end products are eventually absorbed into the surrounding tissues and lymph until most of the evidence of tissue damage is gone.

• Leukemias:

- Uncontrolled production of W.B.C.s is caused by cancerous mutation of myelogenous and lymphogenous cells. Leukemias are divided into
- Lymphogenous leukemia.
- 2 Myelogenous leukemia.

The effect of leukemia is metastatic growth of leukemia cells in abnormal areas of the body.

- Almost all leukemias spread to the spleen, lymph nodes, liver, and others especially vascular region. In myelogenous leukemia, the cancerous process produce partially differentiated cells, resulting in what might be called:
- Neutrophilic leukemia.
- 2 Eosinophilic leukemia.
- 3. Basophilic leukemia.
- 4. Monocytic leukemia.

• Most frequently, however, the leukemia cells are bizarre and undifferentiated and not identical to any of the normal W.B.C.s. usually the more undifferentiated the cells, the more acute is the leukemia, often leading to death within few months if untreated.

Leucopenia or agranulocytosis:

- A clinical condition known as leucopenia occurs in which the bone marrow stops producing W.B.C.s leaving the body unprotected against bacteria and other agents that might invade the tissues. Without treatment, death often is less than a week after acute total leucopenia begins. This results from different causes:
- 1. Irradiation of the body by gamma rays caused by a nuclear explosion.
- 2. Explosion to drugs and chemicals that contain benzene or other is likely to cause aplasia of the bone marrow.

Thank you..