40.2C: White Blood Cells

White blood cells, also called leukocytes, play an important role in the body’s immune response by identifying and targeting pathogens.

Learning Objectives

• Explain the structure and function of white blood cells

Key Points

• White blood cells contain nuclei; they can be divided into granulocytes (e.g. neutrophils, eosinophils, and basophils) and agranulocytes (e.g. monocytes and lymphocytes).
• White blood cells can become macrophages at sites of infection or inflammation or they can circulate in the bloodstream searching for damaged tissue or foreign particles.
• Lymphocytes make up the majority of the cells in the immune system; they include B cells, T cells, and natural killer cells, all of which attack foreign particles or cells such as viruses, fungi, bacteria, transplanted cells, and cancer cells.

Key Terms

• macrophage: a white blood cell that phagocytizes necrotic cell debris and foreign material, including viruses, bacteria, and tattoo ink; part of the innate immune system
• pathogen: any organism or substance, especially a microorganism, capable of causing disease, such as bacteria, viruses, protozoa, or fungi
White Blood Cells

White blood cells, also called leukocytes (leuko = white), make up approximately one percent, by volume, of the cells in blood. The role of white blood cells is very different from that of red blood cells. They are primarily involved in the immune response to identify and target pathogens, such as invading bacteria, viruses, and other foreign organisms. White blood cells are formed continually; some live only for hours or days, while some live for years.

The morphology of white blood cells differs significantly from red blood cells. They have nuclei and do not contain hemoglobin. The different types of white blood cells are identified by their microscopic appearance after histologic staining. Each has a different, specialized function. One of the two main groups are the granulocytes, which contain granules in their cytoplasm, and include the neutrophils, eosinophils, and basophils (a). The second main group is the agranulocytes, which lack granules in their cytoplasm, and include the monocytes and lymphocytes (b).

Figure 1: Types of white blood cells: (a) Granulocytes (neutrophils, eosinophils and basophils) are characterized by a lobed nucleus and granular inclusions in the cytoplasm. Granulocytes are typically first-responders during injury or infection. (b) Agranulocytes include lymphocytes and monocytes. Lymphocytes, including B and T cells, are responsible for adaptive immune response. Monocytes differentiate into macrophages and dendritic cells, which in turn respond to infection or injury.

Some white blood cells become macrophages that either stay at the same site or move through the blood stream and gather at sites of infection or inflammation where they are attracted by chemical signals from foreign particles and damaged cells. Lymphocytes are the primary cells of the immune system. They include B cells, T cells, and natural killer cells. B cells destroy bacteria and inactivate their toxins; they also produce antibodies. T cells attack viruses, fungi, some bacteria, transplanted cells, and cancer cells. Natural killer cells attack a variety of infectious microbes and certain tumor cells.

One reason that HIV poses significant management challenges is because the virus directly targets T cells by gaining entry through a receptor. Once inside the cell, HIV then multiplies using the T cell’s own genetic machinery. After the HIV virus replicates, it is transmitted directly from the infected T cell to macrophages. The presence of HIV can remain unrecognized for an extensive period of time before full disease symptoms develop.