Leukocytes and the Immune Response

Background

The human immune response involves organs and tissues from number of different body systems. Lymph nodes and spleen from the lymphatic system, bone marrow from the skeletal system, and the thymus gland from the endocrine system are all involved in defending the body from foreign proteins. Much of the immune response is mediated by white blood cells (leukocytes) from the cardiovascular system.

A healthy human will typically have between 5,000 and 10,000 leukocytes per cubic millimeter of blood. While this may seem like a large number, the white blood cells only account for 5% of the total blood cells. When the total blood volume (which includes the fluid matrix or plasma) is considered, leukocytes account for between 2 and 3% of that volume. These numbers will change in response to infection or disease, making the white cell count an important diagnostic tool.

At the cellular level, there are five (5) observable types of leukocyte: neutrophils; basophils; eosinophils; monocytes and lymphocytes. The T-cells and B-cells are simply biochemical variations of lymphocytes. These five varieties are characterized by outward appearance, size and staining properties, and each is responsible for a specific aspect of the immune response. In this lab, we will observe and identify the five types of white blood cell. We will also perform a differential white cell count to determine relative numbers of each cell type in a healthy person. Lastly, we will look at some pathological blood samples and observe the leukocyte response in those instances.

Focus Questions

- What are the different types leukocyte and how are they identified microscopically?
- How is a differential white cell count performed?
- What are the normal values of a differential white cell count and what do variations from the normal indicate?
- How are leukocytes affected by different types of pathological conditions?

Procedure

Part A. Observing Leukocytes

1. Obtain a prepared blood smear from the “normal” slide tray.
2. Observe the slide using 100x and 400x magnification. Use diagrams and information from your textbook to identify each of the five white blood cell types.
3. Make an accurate biological drawing of one example of a granulocyte. Label the following structures: nucleus; cell membrane; cytoplasmic granules. Measure the diameter of the cell. Write a brief paragraph on the function of the leukocyte type you have drawn. You will be graded on your identification and the accuracy of your measurements.
4. Make an accurate biological drawing of one example of an agranulocyte. Label the following structures: nucleus; cell membrane; cytoplasm. Measure the diameter of the cell. Write a brief paragraph on the function of the leukocyte type you have drawn. You will be graded on your identification and the accuracy of your measurements.

Part B. Differential White Cell Count

1. Focus on the cells at one end of your blood smear using the 400x objective.
2. Using the mechanical stage, move the slide back and forth slowly, following a path that avoids passing over the same area twice.
3. Each time you encounter a leukocyte, identify it and record as a tally in the data table below.
4. Continue searching for and identifying leukocytes until you have recorded 100 cells in the data table. The percentage of each cell type is equal to the total number of each type of white blood cell that you counted.

5. Complete the data table by researching the normal percentage for each leukocyte.

**Part C. Pathological Blood Smears**

1. Obtain a blood smear from the “pathological” slide tray.
2. Observe the slide under both 100x and 400x objectives, with special attention to differences in the leukocytes.
3. Perform a differential white cell count on the pathological blood. Record your results in the data table provided.
4. Make a qualitative written observation of your slide. Focus your observations on structural differences between the normal blood smear (from part A) and the pathological blood smear.
5. Compare your description with the description/diagram of another group’s pathological blood smear.

**Analysis and Conclusion**

1. Briefly summarize the functional role of each leukocyte type. Be sure to specifically identify its role in the immune response.

2. Using general percentages, predict the results of a differential white cell count for each of the following: a.) bacterial infection; b.) allergic response; c.) transplant rejection. Provide a brief explanation for the predicted differences/changes in the percentage of white blood cells.

3. Research any one of the diseases represented by the pathological blood smears (it can, but doesn’t have to, be the one you described in Part C). Briefly discuss the cause, effect and treatment of the condition.