Immunology part 1

Introduction to Immunology and its principles

Immunology refers to the study of the immune system of organisms and the processes the host employs in order to maintain *homeostasis* of its internal environment, when it is "under attack" by foreign substances/toxins/cells which come either from its internal or external environment. The name of this branch of Biology is derived from the Latin word *immunitas,* which was first used to describe the protection Roman senators possessed from prosecutors (free from burden), and the Greek word *logos*, which means "the study of".

During the long course of evolution, more advanced organisms have developed various mechanisms which serve to protect them from anything that isn't identified as intrinsic, or its own. These factors, such as tumor cells, pathogens such as bacterial or viral cells, as well as parasites, threaten to overthrow homeostasis and weaken the organism and its ability to function normally. The cells and molecules which are responsible for protection make up the immune system, and their coordinated activity as a response to threats make up the immune response. Therefore, the main functions of the immune system are:

- Defense from infections
- Protection and defense from tumors
- Preserving homeostasis

Organisms are constantly under the influence of other organisms, and some of those interactions can be a threat. Due to this, the need to have some sort of defense mechanism is absolutely necessary in order to survive. The main principle of the immune system is to recognize potential threats, in the form of cells/substances, etc. It must differentiate between its own cells and tissue and foreign threats. In cases where this differentiation is unable to occur, **autoimmune diseases** can be the result – immune mechanisms attack the organism's own tissues/molecules (primarily protein molecules).

There are two types of immunity:

1. **Nonspecific immunity** (innate)
2. **Specific immunity** (adaptive) – with two components:
    a. **Humoral immunity** – mediators are macromolecules, such as B lymphocytes and antibodies.
    b. **Cellular immunity** – mediators are T lymphocytes.

Both types are components of an integrated immune response in which numerous cells and molecules function as a cooperative unit. The immune system functions based on the principles of **recognition** and **memory**. Usually, initial contact with a pathogen results in the manifestation

forms which are recognizable to other immune cells. Therefore, macrophages serve as a link between the two types of immunity.

All phagocytic cells function similarly. They all use three possible methods of inactivating and destroying pathogens.

1. Via production of lysosomal antibacterial substances:
    a. Lysozyme
    b. Proteolytic enzymes
    c. Hydrolytic enzymes
    d. Lactoferrin
    e. Cathepsin
2. Oxygen-dependent mechanisms:
    a. Require the process of **halogenation** of bacterial proteins (a process catalyzed by the enzyme myeloperoxidase).
    b. Hydrogen peroxide (H_2O_2) and other free reactive radicals
3. Oxygen-dependent myeloperoxidase-independent mechanisms:
    a. O_2, OH^-, H_2O_2
    b. No myeloperoxidase

NK cells (Natural Killer cells) and K cells (Killer cells)

They account for approximately 15% of lymphocytes in peripheral circulation. These cells are larger than B and T lymphocytes, have a greater amount of cytoplasm and have CD16 and CD56 surface markers. They contain azurophilic granules within their cytoplasm and are hence termed large granular lymphocytes (LGL). They respond fast in response to viral infections as well as in the presence of tumor cells.

K cells attach to target cells, which have previously been surrounded by IgG antibodies, and cause cell lysis.

LAK cells (Lymphokine-activated cells)

These cells are similar to NK cells, but are more efficient. They are designed to destroy malignant cells, as well as transformed, non-malignant cells. They respond to lymphokines, especially IL-2, and lead to the lysis of tumor cells (which may be resistant to NK cells). Therefore, they are able to destroy certain transformed cells which natural killer cells cannot.

Eosinophils

The nuclei within these cells contain two lobes. Within the cytoplasm, eosinophils contain large, elongated granules. These granules contain a crystalline core, called the **inertum**, which