**Lecture 8 General pathology Dr. Ali H. Murad**

***Diseases of the Immune System***

**Immunity**:

It is protection against infections. The immune system is the collection of cells and molecules that are responsible for:

1- Defending our body against pathogenic microbes in our environment.

2- Prevent the proliferation of cancer cells.

3- Mediate the healing of damaged tissue.

Défense against microbes consists of two types of reactions:

**1- Innate immunity** (natural or native immunity): It is mediated by cells and proteins that are always present and act immediately against any infection. The major components of innate immunity are:

a- Epithelial barriers of the skin, gastrointestinal tract, and respiratory tract, which prevent microbe entry.

b- Phagocytic leukocytes (neutrophils and macrophages).

c- A specialized cell type called the natural killer (NK) cell.

d- Several circulating plasma proteins, the most important of which are the proteins of the complement system.

**2- Adaptive immunity** (acquired or specific immunity). It is normally silent and responds (or "adapts") to the presence of an infectious microbes by becoming active for neutralizing and eliminating the microbes. The components of the adaptive immunity are lymphocytes and their products. The terms "immune system" and "immune response" refer to adaptive immunity.



***Types of adaptive immunity:***

**1-Humoral immunity***:* Mediated by soluble antibodyproteins that are produced by **B lymphocytes** (B cells). Antibodies provide protection against extracellular microbes in the blood, mucosal secretions, and tissues.

**2-Cell-mediated (or cellular) immunity***:* Mediated by **T lymphocyte** (T cells) which are important in defenseagainst intracellular microbes. They work by either directlykilling infected cells (by cytotoxic T lymphocytes) or byactivating phagocytes to kill ingested microbes, via theproduction of soluble protein mediators called cytokines(made by helper T cells).When the immune system is inappropriately triggered or notproperly controlled, the same mechanisms that are involvedin host defense will cause tissue injury and disease.

The reaction of the cells of innate and adaptive immunitymay be manifested as **inflammation** which is a beneficialprocess, but it is also the basis of many human diseases.



***Cells and tissues of the immune system:***

1-Lymphocytes, which are the mediators of adaptive immunity.

2-Specialized antigen-presenting cells (APCs), which capture and display microbial and other antigens to the lymphocytes.

3-Various effector cells, that eliminating the antigens (microbes).

**Lymphocytes:**

Lymphocytes are present in the circulation and in various lymphoid organs as two types:

**T lymphocytes**(mature in the thymus).

**B lymphocytes**(mature in the bone marrow).

Each T or B lymphocyte expresses receptors for a single antigen, and the total population of lymphocytes (numbering about 1012 in humans) is capable of recognizing tens or hundreds of millions of antigens*.*

**T Lymphocytes:**

They are the effector cells of cellular immunity and provide important stimuli for antibody responses to protein antigens. T cells do not detect free or circulating antigens. Instead, the vast majority (>95%) of T cells recognize only protein antigens that are displayed on other cells bound to proteins of the major histocompatibility complex (MHC; or human leukocyte antigen [HLA] complex).

The normal function of MHC molecules is to display protein for recognition by T lymphocytes thus perform their function of killing infected cells or activating phagocytes or B lymphocytes that have ingested protein antigens.

**B Lymphocytes**

B cells synthesize antibodies or immunoglobulins=Ig = five classes: IgG, IgM, IgA, IgE and IgD. After stimulation, B cell will be differentiated into **plasma cells** which secrete large amounts of antibodies, which are the mediators of humoral immunity.

**Natural Killer Cells**

They are lymphocytes of innate immunity which have limited setof activating receptors so they do not have specificities as diverseas do T cells or B cells. They can recognize molecules expressedon stressed or infected cells or cells with DNA damage, and then kill these cells.

NK cells express inhibitory receptors that recognize self class I MHC molecules, which are expressed on all healthy cells; so, they avoid attacking normal host cells. Infections (especially viral infections) and stress are associated with loss of expression of class I MHC molecules so NK cells are released from their inhibition and destroy the unhealthy host cells.

**Antigen-Presenting Cells**

These cells are specialized to capture microbial antigens and display them to lymphocytes. These APCs are dendritic cells (DCs) and macrophage.

**1-Dendritic Cells**

Cells with fine dendritic cytoplasmic processes occur as two functionally distinct types. **InterdigitatingDCs**, are non-phagocytic cells that express high levels of class II MHC and T-cell co stimulatory molecules.

 Immature DCs reside in epithelia, where they are located to capture entering microbes; an example is the Langerhans cell of the epidermis.

Mature DCs are present in the T-cell zones of lymphoid tissues, where they present antigens to T cells circulating through these tissues. DCs are also present in the interstitium of many nonlymphoid organs, such as the heart and lungs, where they can capture the antigens of microbes that have invaded the tissues.

***Follicular dendritic cells*** (FDCs), located in the germinal centres of lymphoid follicles in the spleen and lymph nodes. These cells bear receptors for the Fc tails of IgG and for complement proteins, and hence efficiently trap antigen bound to antibodies and

complement.

**2- Macrophages**:

Ingest microbes and other particulate antigens and display them for recognition by T lymphocytes which in turn activate the macrophages to kill the microbes, the central reaction of cell mediated immunity.

**Effector Cells**

Many different types of leukocytes perform the adaptive immune response, which is to eliminate infections. These include **NK cells**, **Antibody-secreting plasma cells**, **T lymphocytes**, **Macrophages**

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T lymphocytes secrete **cytokines** that recruit and activate other leukocytes, such as neutrophils and eosinophils, which will function in defence against various pathogens.

***Lymphoid Tissues:***

Divided into:

1- Generative (primary) organs, where lymphocytes express antigen receptors and mature. These include the thymus and bone marrow.

2- Peripheral (secondary) lymphoid organs, where adaptive immune responses develop. The peripheral organs are the lymph nodes, spleen, and mucosal and cutaneous lymphoid tissues