**Lecture 9 General pathology Dr. Ali H. Murad**

***Cells and Tissues of Immune System:*** Summary

**Lymphocytes** are the mediators of adaptive immunity and the only cells that produce specific and diverse receptors for antigens.

**T (Thymus-derived)** **lymphocytes** express antigen receptors called T cell receptors (TCRs) that recognize protein antigens that are displayed by MHC molecules on the surface of antigen presenting cells.

**B (Bone marrow-derived) lymphocytes** express membrane bound antibodies that recognize a wide variety of antigens. B cells are activated to become plasma cells, which secrete antibodies or immunoglobulins.

**Natural killer (NK)** cells kill cells that are infected by some microbes, or are stressed and damaged beyond repair. NK cells express inhibitory receptors that recognize MHC molecules that are normally expressed on healthy cells, and are thus prevented from killing normal cells.

**Antigen-presenting cells (APCs)** capture microbes and other antigens, transport them to lymphoid organs, and display them for recognition by lymphocytes. The most efficient APCs are: dendritic cells, which live in epithelia and most tissues and macrophages which ingest microbes and other particulate antigens and display them for recognition by T lymphocytes.

Under normal conditions, the immune response prevents disease, but occasionally, the inappropriate activation of the immune system can lead to debilitating or life-threatening illnesses, like:

1- Allergic or hypersensitivity reactions.

2- Transplantation immunopathology.

3- Autoimmune disorders.

4- Immunodeficiency states.

***Allergic or hypersensitivity disorders:***

**Hypersensitivity**: itis defined as an exaggerated immune response to a foreign agent resulting in injury to the host. It is caused by immune responses to environmental antigens called allergens that produce inflammation and cause tissue injury.

**Allergens**: Any foreign substances capable of inducing an immune response. Many different chemicals of natural and synthetic origin are known as allergens.

Complex natural organic chemicals, especially proteins, are more likely to cause an immediate hypersensitivity response, whereas simple organic compounds, inorganic chemicals, and metals more commonly cause delayed hypersensitivity reactions. Exposure to the allergen can be through inhalation, ingestion, injection, or skin contact.

**Hypersensitivity disorders are of four types:**

Type I: IgE-mediated disorders.

Type II: Antibody-mediated (cytotoxic) disorders.

Type III, Immune-Complex Disorders

Type IV: Cell-mediated hypersensitivity reactions.

***Type I, IgE-Mediated Disorders (Immediate type):***

They are immediate-type of hypersensitivity reactions that are triggered by binding of an allergen to a specific IgE found on the surface of mast cells or basophils.

Mast cells, (tissue cells), and basophils, (blood cells), are derived from blood precursor cells. Mast cells are distributed throughout connective tissue, near surfaces that are exposed to environmental antigens especially in areas beneath the skin and mucous membranes of the respiratory, gastrointestinal, and genitourinary tracts, and adjacent to blood and lymph vessels.

Basophils are similar to mast cell in many aspects but its role in this type of hypersensitivity is not well established because it is not present in the tissues but circulating in the blood.

Mast cells and basophil shave granules that contain potent mediators of allergic reactions. During the sensitization, the allergen-specific IgE antibodies attach to receptors on the surface of these cells triggers a series of events that lead to degranulation of the sensitized cells, causing release of their allergy-producing mediators which include:

**Histamine**, a potent vasodilator that increases the permeability of capillaries and venules, causes bronchoconstriction and increased secretion of mucus. **Acetylcholine** produces bronchial smooth muscle contraction and dilation of small blood vessels.

**Proteases** generate kinins and cleave complement components to produce additional chemotactic and inflammatory mediators.

**Leukotrienes** and **prostaglandins** produce responses similar to those of histamine and acetylcholine, although their effects are delayed and prolonged by comparison.

**Platelet-activating factor** result in platelet aggregation, histamine release, and bronchospasm. It also acts as a chemotactic factor for neutrophils and eosinophils.

**Cytokines** recruit and activate a variety of inflammatory cells.



Type I hypersensitivity reactions may present as a systemic disorder (anaphylaxis) or a localized reaction (atopy).

**Systemic Anaphylactic Reactions:**

Result from injected allergens (e.g., penicillin, radiographic contrast dyes, and bee or wasp stings).

More rarely, they may result from ingested allergens (seafood, nuts, and legumes).

**Sign and symptoms**: Anaphylaxis has a rapid onset, often within minutes, there will be:

1- Itching.

2- Urticaria.

3- Gastrointestinal cramps.

4- Difficulty in breathing caused by bronchospasm.

5- Angioedema (swelling of face and throat) may develop, causing upper airway obstruction.

6- Massive vasodilation may lead to peripheral pooling of blood, a profound drop in blood pressure, and life-threatening circulatory shock.

**Localized Atopic Disorders:**

Occur when the antigen is confined to a particular site, usually related to the route of exposure. It is genetically determined and the term atopy is often used to imply a hereditary predisposition to such reactions.

They have high serum levels of IgE and increased numbers of basophils and mast cells and they are also responsive to the chemical mediators of allergic reactions. Atopic disorders include food allergies, allergic rhinitis (hay fever), allergic dermatitis, and certain forms of bronchial asthma.

***Type II, Antibody-Mediated Cytotoxic Disorders:***

They are the end result of direct interaction between IgG and IgM class antibodies and tissue or cell surface antigens, with subsequent activation of complement- or antibody dependent cell-mediated cytotoxicity.

Examples of type II reactions include mismatched blood transfusions,hemolytic disease of thenewborn caused by ABO or Rh incompatibility, and certain drug reactions. In

the latter, the binding of certain drugs to the surface of red or white blood cells elicits an antibody and complement response that lyses the drug-coated cell. Lytic drug reactions can produce transient anemia, leukopenia, or thrombocytopenia, which are corrected by the removal of the offending drug.

