Course: Immunology

Lecturer: Dr. Weam Saad

Lecture: Innate Immunity

Innate (non-specific Immunity)

Human body is continuously exposed to pathogenic microorganisms. The immune system is composed of two major subdivisions, the innate or nonspecific immune system and the adaptive or specific immune system. The innate immune system is our first line of defense against invading organisms while the adaptive immune system acts as a second line of defense and gives protection against re-exposure to the same pathogen. Each of the major subdivisions of the immune system has both cellular and humoral components by which they carry out their protective function and help each other to do these functions.

The main function of the immune system is to distinguish between self and non-self a protein which is necessary to protect the organism from invading pathogens and to eliminate modified or altered cells (e.g. malignant cells). Since pathogens may replicate intracellularly (viruses and some bacteria and parasites) or extracellularly (most bacteria, fungi and parasites), different components of the immune system have evolved to protect against these different types of pathogens.

Innate Host defenses:

A. Anatomical barriers against infections:

1. Mechanical (physical) factors

The epithelial surfaces form a physical barrier that is very impermeable to most infectious agents. Thus, the skin acts as the first line of defense against invading organisms. The shedding of skin epithelium also helps remove bacteria and other infectious agents that have adhered to the epithelial surfaces. Movement due to cilia or peristalsis helps to keep air passages and the gastrointestinal tract free from microorganisms. The

flushing action of tears and saliva helps prevent infection of the eyes and mouth. The trapping affect of mucus that lines the respiratory and gastrointestinal tract helps protect the lungs and digestive systems from infection.

2. Chemical factors

Fatty acids in sweat inhibit the growth of bacteria. Lysozyme and phospholipase found in tears, saliva and nasal secretions can breakdown the cell wall of bacteria and destabilize bacterial membranes. The low pH of sweat and gastric secretions prevents growth of bacteria.

3. Biological factors

The normal flora of the skin and in the gastrointestinal tract can prevent the colonization of pathogenic bacteria by secreting toxic substances or by competing with pathogenic bacteria for nutrients or attachment to cell surfaces.

B. Humoral barriers against infections:

The anatomical barriers are very effective in preventing colonization of tissues by microorganisms. However, when there is damage to tissues the anatomical barriers are breeched and infection is occurs. Once infectious agents have penetrated tissues, another innate defense mechanism comes into play, namely acute inflammation. Humoral factors play an important role in inflammation, which is characterized by edema and the activation of phagocytic cells. These humoral factors are found in serum or they are formed at the site of infection. They contain:

1. **Complement system:** The complement system is the major humoral nonspecific defense mechanism (see the lecture of complement). Once activated complement can lead to increased vascular permeability, activation of phagocytic cells, and lysis and opsonization of bacteria.

2. **Interferons**: Interferons are proteins that can limit virus replication in cells.

3. **Lysozyme:** Lysozyme breaks down the cell wall of bacteria.

C. Cellular barriers against infections:

These cells are the main line of defense in the nonspecific immune system, they include;

1. Polymorphonuclear cells (PMNs): Microphage, include Neutrophils, Eosinophils and Basophils), they migrate to the site of infection where they phagocytose invading organisms and kill them intracellularly. In addition, PMNs contribute to tissue damage that occurs during inflammation.
2. Monocytes and Macrophages: Macrophage, Tissue macrophages and monocytes function is phagocytosis and intracellular killing of microorganisms. In addition, macrophages are capable of extracellular killing of infected or transformed cells (self-target). Also, macrophages have role in tissue repair and act as antigen presenting cells APC, which are required for the induction of specific immune responses.

Phagocytosis: A very important process during non-specific immune response when specialized cells engulf foreign body like bacteria or molecule like toxin or virus. The phagocytosis has four steps:

1. Chemotaxis.
2. Endocytosis.
3. Phagolysosome formation and degradation of foreign substances.
4. Lysis and excretion.

The cells that able to do phagocytosis are (monocytes, macrophage, PMNs and Dendric cells). The results of phagocytosis are:

1. Complete destruction of foreign body and excretion (PMNs)
2. Complete destruction of foreign body and some parts (polypeptides) of it will be processed and presented on the surface of the phagocytic cells (monocytes, macrophage and dendric cells) then the phagocytic cell will be antigen presenting cell (APC).