



Tikrit University
College of Veterinary Medicine

Lect. 1-Immunology

Subject name:

Properties and overview of immune systems

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Lecture 1

Junior students

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Properties and overview of immune systems

The term **immunity** derived from latin word immunitas which referred to the protection

The **immune system** consists of two important parts

- A- Cells
- B- Molecules

The collection and coordination of cells and molecules which trigger and elicit the immune system called **immune response**

The **physiological function** of the immune system is the defense against microbes as well as foreign substances such as protein , polysaccharides and small chemicals.

Types of immunity

1-Innate immunity (natural or native immunity) :

Innate immunity provides the early line of defense against microbes which consists of cellular and biochemical defense mechanisms. These mechanisms react to products of microbes and injured cells, and they respond essentially the same way to repeated exposures.

The components of innate immunity are consists of :

- A- Physical and chemical barriers: such as epithelial and antimicrobial chemicals produced by epithelial surfaces
- B- Cellular components are phagocytes which include:
 - Neutrophils
 - Macrophages
 - Dendritic cells
 - Natural killers cells (NK cells)
 - Innate lymphoid cells (ILCs)
- C- Blood proteins: which including
 - Members of complement system
 - Mediators of inflammation

2-Adaptive immunity (Specific or Acquired immunity):

The adaptive immune system recognizes and reacts to a large number of microbial and nonmicrobial substances. The defining characteristics of adaptive immunity are the ability to distinguish different substances, called specificity

The components of adaptive immunity are consists of:

- 1- **Lymphocytes:** which including
 - A- T cells
 - B- B cells
- 2- **Antigenic presenting cells (APCs)**
- 3- **Effector cells**

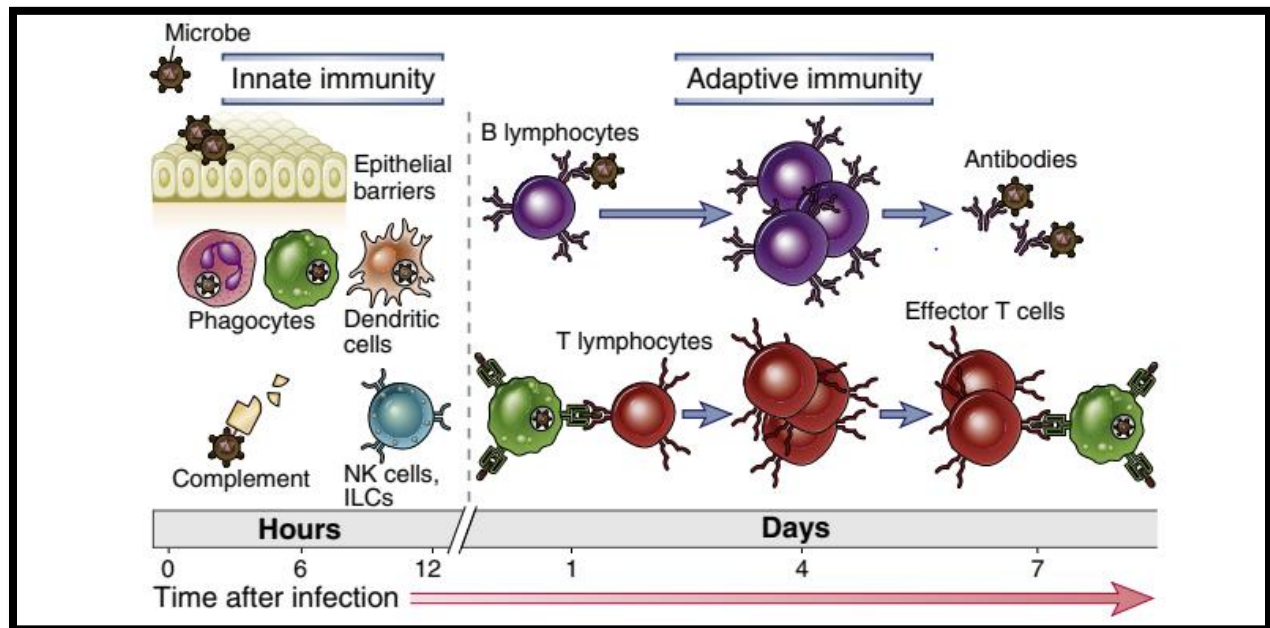


Figure 1-1: The mechanism of innate immunity provide the initial defense against infections.

The adaptive immune response develop later and require the activation of lymphocytes

Types of Adaptive Immunity

1-Humoral immunity

This type of immunity is mediated mainly by **Antibodies (Ab)** which define as molecules that present in the blood and mucosal secretions and these molecules produced by **B Lymphocytes (B cells)**.

The function of the antibodies mainly through binding to the microbial antigens and their toxins then neutralizing these antigenic components, the function of antibodies is specifically toward the extracellular microbes. These antibodies promote the ingestion of microbes and triggers the inflammatory mediators from the cells then actively transported into the lumen of mucosal organs and through the placenta to provide protection for the newborn against infections.

2-Cellular immunity or cell mediated immunity

This type of immunity mediated by T cells, this type of immunity specified against intracellular microbes such as viruses and some other bacteria which are survived and proliferate inside the phagocytes and becoming inaccessible to the circulating antibodies which are not able to destroy them , so in this case the T cells will take the role in order to eliminate these intracellular microorganisms.

The defense against such infections is a function of cell-mediated immunity, which promotes the destruction of microbes residing in phagocytes or the killing of infected cells to eliminate reservoirs of infection.

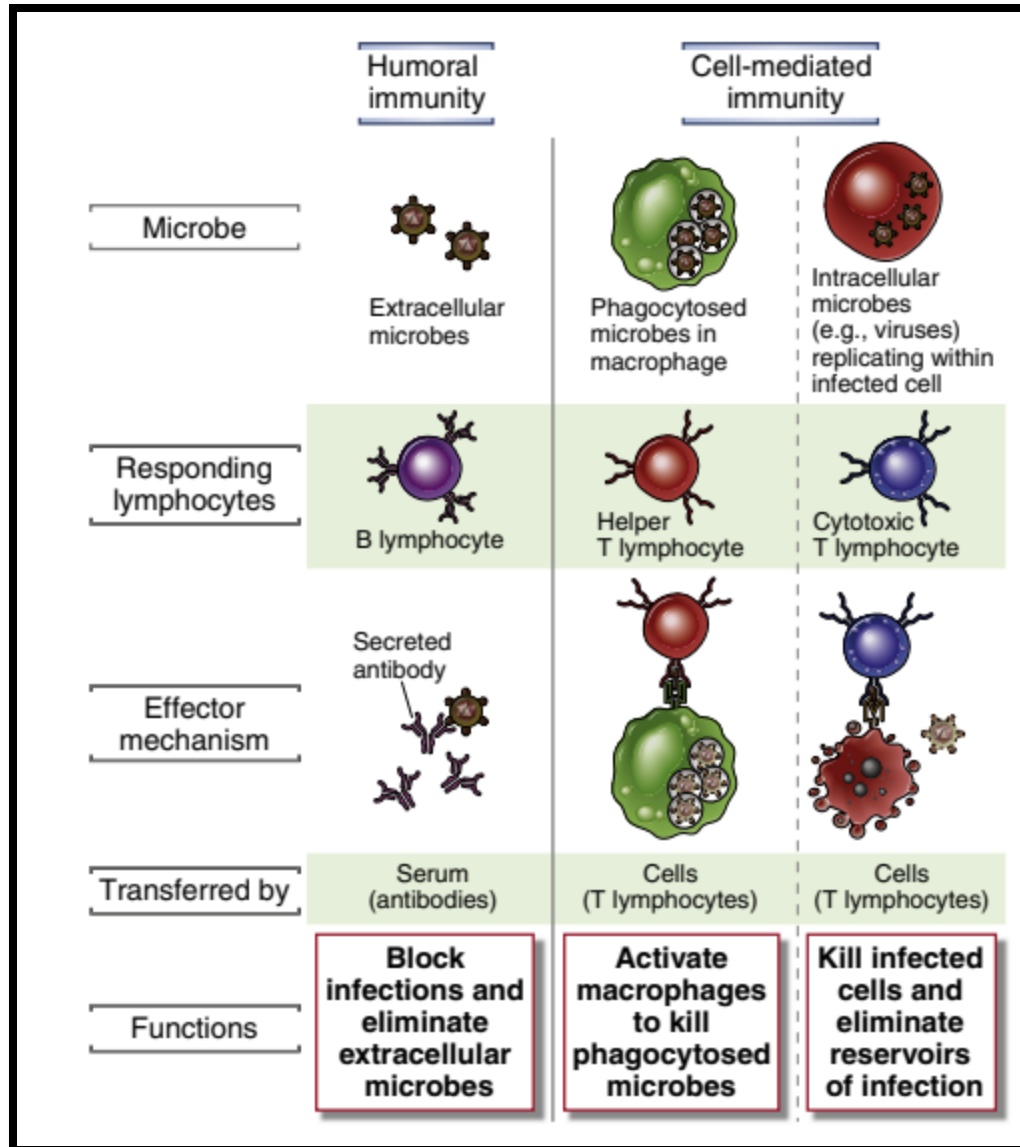


Figure 1-2 : Types of adaptive immunity. In humoral immunity, B lymphocytes secrete antibodies that prevent infections and eliminate extracellular microbes. In cell-mediated immunity, helper T lymphocytes activate macrophages to kill phagocytosed microbes, or cytotoxic T lymphocytes directly destroy infected cells.

What is cytokines ?

Define as large groups of secreted proteins which regulate and coordinate the activities of immune cells in both innate and adaptive immunity .All cells of immune system secrete some cytokines and express specific signaling receptors for these cytokines.

The cytokines have three nomenclature such as **Interleukins** , **interferons** and **chemokines** which all of these three types have different immune functions based on their types.

Cellular components of the immune system

The cells that involves in the response for microbes including :

1- Antigenic presenting cells

The initiation and development of adaptive immune responses require that antigens be captured and displayed to specific lymphocytes. The cells that serve this role are called antigen-presenting cells (APCs). The most specialized APCs are dendritic cells, which capture microbial antigens that enter from the external environment, transport these antigens to lymphoid organs, and present the antigens to naive T lymphocytes to initiate immune responses.

2- Lymphocytes: which including B cells and T cells are the cells that respond to antigens , so the T cells considered the mediators for cellular immunity and B cells considered the mediators for humoral immunity

B cells considered the only cells that are capable of producing antibodies which are fight and recognize extracellular antigens.

T lymphocytes are the only cells that are recognizing the intracellular microbes and they are cooperating with antigenic presenting cells as well as responsible for killing the infected cells

T lymphocytes fighting the microbes by lymphocytes have a restricted specificity for antigens; they recognize peptides derived from foreign proteins that are bound to host proteins and this recognition happened by major histo compatibility complex (MHC) molecules.

T lymphocytes consist of functionally distinct populations, the best defined of which are **helper T cells** and **cytotoxic (or cytolytic) T lymphocytes (CTLs)**. In response to antigenic stimulation, helper T cells secrete cytokines, which are responsible for many of the cellular responses of innate and adaptive immunity and thus function as the “messenger molecules” of the immune system. The cytokines secreted by helper T lymphocytes stimulate the proliferation and differentiation of the T cells themselves and activate other cells, including B cells, macrophages, and other leukocytes. CTLs kill cells that infected by viruses and other intracellular microbes. Some other T lymphocytes, which are called **regulatory T cells**, and their function mainly to inhibit and regulate immune responses.

The activation of lymphocytes by antigen leads to the generation of numerous mechanisms that function to eliminate the antigen. Antigen elimination often requires the participation of cells that are called **effector cells** because they mediate the final effect of the immune response, which is to get rid of the microbes. Activated T lymphocytes, mononuclear phagocytes, and other leukocytes function as effector cells in different immune responses.

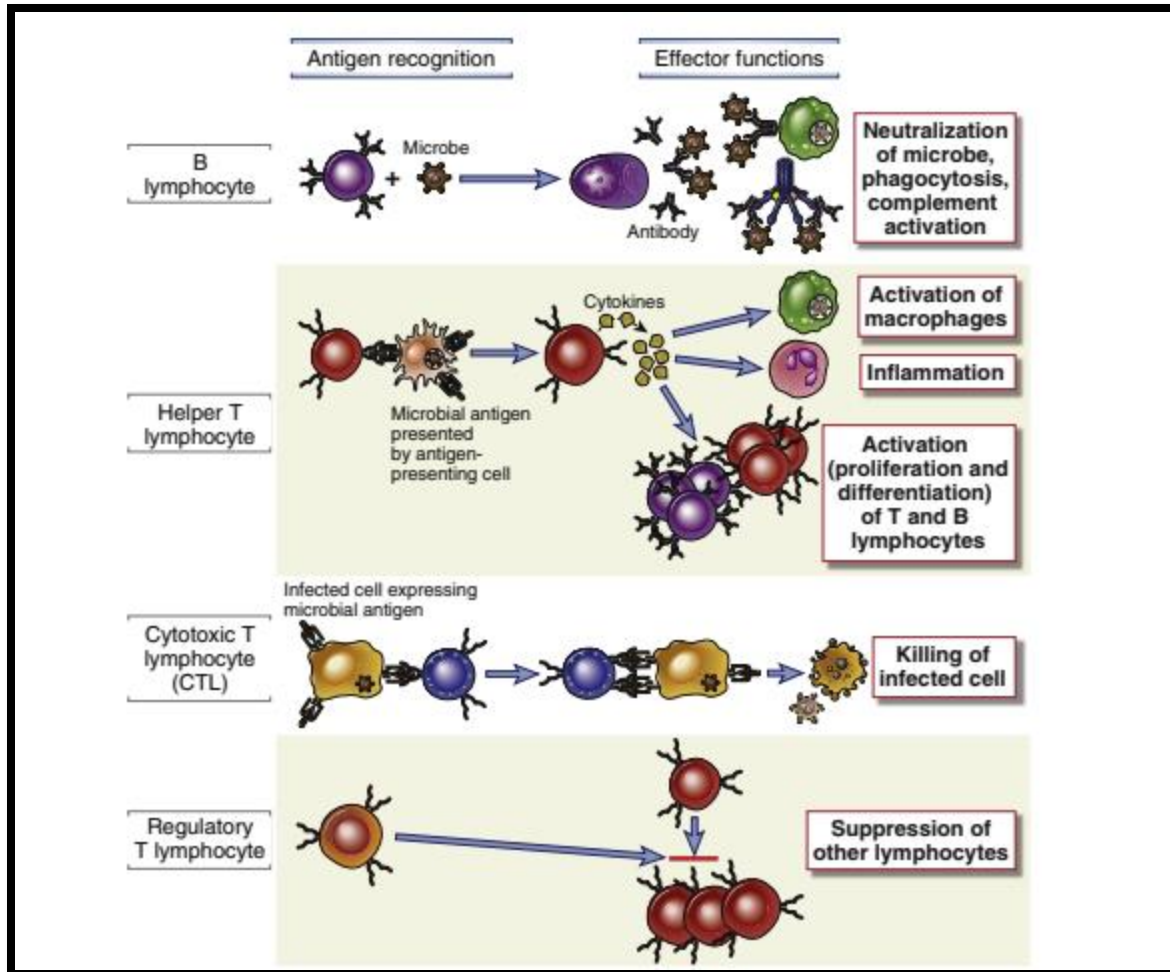


FIGURE 1-3: Classes of lymphocytes. B lymphocytes recognize soluble antigens and develop into antibody-secreting cells. Helper T lymphocytes recognize antigens on the surfaces of antigen-presenting cells and secrete cytokines, which stimulate different mechanisms of immunity and inflammation. Cytotoxic T lymphocytes recognize antigens on infected cells and kill these cells. Regulatory T cells suppress and regulates immune responses in general .

Some features of adaptive immune response :

What does mean epitopes(determinants) ?

Define as a parts or single portions of the antigen which is recognized by the lymphocytes so these lymphocytes receptors on their surfaces by which they can differentiate between different antigens.

The ability of the lymphocytes to make different clones of lymphocytes called **lymphocyte repertoire**. The immune system of each individual can able to determine or discriminate about 10 million to 1 Billion epitopes .

What does mean memory Immunity ?

The ability of the immune system to respond to the antigen , enables this system to respond again with larger and more rapid response during the second exposure to the same antigen , this called secondary immune response or immunologic memory .

Immunologic memory occurs because each exposure to an antigen generates long-lived memory cells specific for the antigen. In addition, memory cells have special characteristics that make them more efficient at responding to and eliminating the antigen than are naive lymphocytes that have not previously been exposed to the antigen. For instance, memory B lymphocytes produce antibodies that bind antigens with higher affinities than do antibodies produced in primary immune responses, and memory T cells react much more rapidly and vigorously to antigen challenge than do naive T cells.

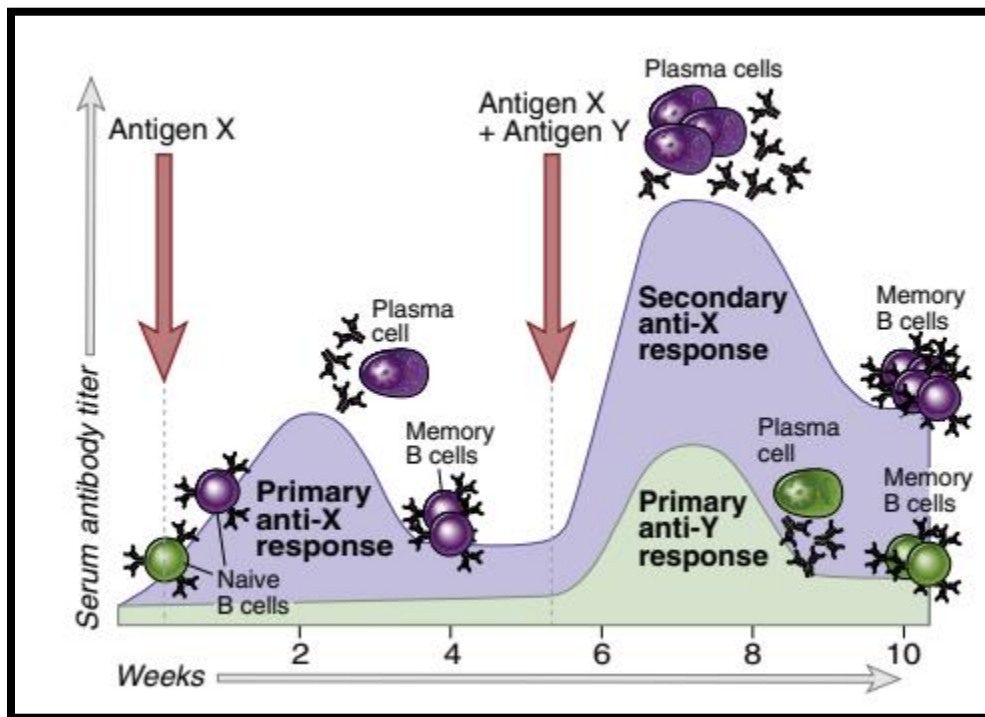


Figure 1- 4: Specificity, memory, and contraction of adaptive immune responses. Antigens X and Y induce the production of different antibodies (specificity). The secondary response to antigen X is more rapid and larger than the primary response (memory). Antibody levels decline with time after each immunization (contraction, the process that maintains homeostasis). The same features are seen in cell-mediated immune responses.

What does mean clonal expansion?

After the exposure of the lymphocytes to the antigen, these lymphocytes going through massive proliferation so they can keep up their activity against the invasion of the antigen.

What does mean immune homeostasis?

The activation and proliferation of lymphocytes against different antigens is very essential to protect our body, however this level of activation can not be continued after the antigen cleared and removed from the body because this level of activation may hurt and damage the cells if the body in case it takes longer than what it needed , so the homeostasis is the next step where the lymphocytes and other immune cells to back to their normal level and keep up the immunological equilibration and homeostasis .

What does mean Apoptosis?

The term apoptosis can be defined as a natural biological process of programmed cell death in which the cells destroy themselves for maintaining the normal functioning of the body.

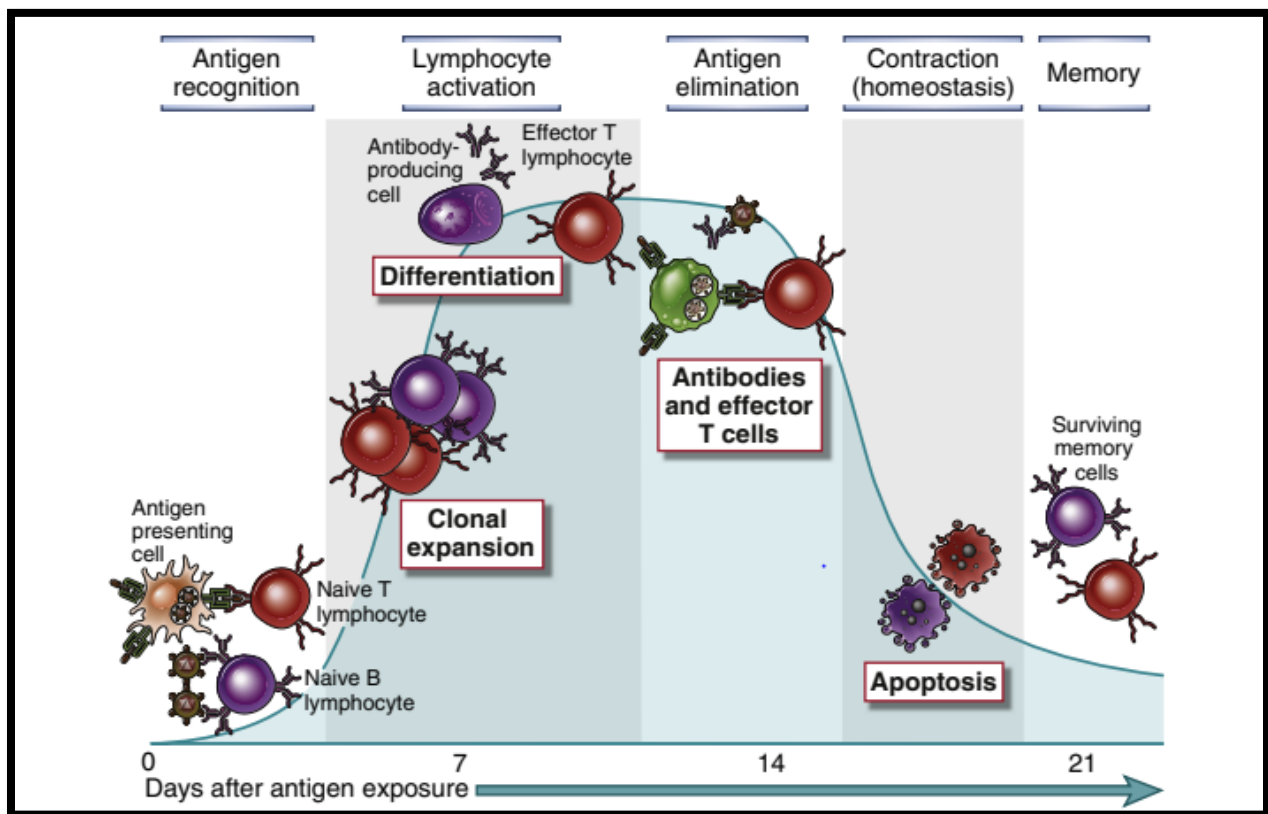


Figure 1-5: Phases of adaptive immune response the first three being the recognition of antigen, the activation of lymphocytes, and the elimination of antigen (the effector phase). The response contracts (declines) as antigen-stimulated lymphocytes die by apoptosis, restoring homeostasis, and the antigen-specific cells that survive are responsible for memory. The duration of each phase may vary in different immune responses. The y-axis represents an arbitrary measure of the magnitude of the response. These principles apply to humoral immunity (mediated by B lymphocytes) and cell-mediated immunity (mediated by T lymphocytes).