

## CLASSIFICATION OF THE HUMAN ORGANISM IMMUNE SYSTEM AND VARIOUS INFECTIOUS DISEASES FOUND IN IT

**Kaxarov Abdulkaxar Nabijonovich**

Department of infectious diseases , Andijan State Medical Institute

**Annotation:** All living things are subject to attack from disease-causing agents. Even bacteria, so small that more than a million could fit on the head of a pin, have systems to defend against infection by viruses. This kind of protection gets more sophisticated as organisms become more complex.

**Key words:** immune system, disease, infection, bacteria, virus.

Multicellular animals have dedicated cells or tissues to deal with the threat of infection. Some of these responses happen immediately, so that an infecting agent can be quickly contained. Other responses are slower, but are more tailored to the infecting agent. Collectively, these protections are known as the **immune system**. The human immune system is essential for our survival in a world full of potentially dangerous microbes, and serious impairment of even one arm of this system can predispose to severe, even life-threatening, infections.

The human immune system has two levels of immunity: specific and non-specific immunity. Through non-specific immunity, also called innate immunity, the human body protects itself against foreign material perceived to be harmful. Microbes as small as viruses and bacteria can be attacked, as can larger organisms such as worms. Collectively, these organisms are called pathogens when they cause disease in the host.

All animals have innate immune defenses against common pathogens. These first lines of defense include outer barriers like the skin and mucous membranes. When pathogens breach the outer barriers, for example through a cut in the skin or when inhaled into the lungs, they can cause serious harm.

Some white blood cells (phagocytes) fight pathogens that make it past outer defenses. A phagocyte surrounds a pathogen, takes it in, and neutralizes it.

While healthy phagocytes are critical to good health, they are unable to address certain infectious threats. Specific immunity is a complement to the function of phagocytes and other elements of the innate immune system.

In contrast to innate immunity, specific immunity allows for a targeted response against a specific pathogen. Only vertebrates have specific immune responses.

White blood cells known as lymphocytes are vital to the specific immune response. They are produced in the bone marrow, and mature into one of several subtypes. Two of these subtypes are T cells and B cells.

An antigen is a foreign material that triggers a response from T and B cells. The human body has B and T cells specific to millions of different antigens. We usually think of antigens as part of microbes,

but antigens can be present in other settings. For example, if a person received a blood transfusion that did not match his blood type, it could trigger reactions from T and B cells.

A useful way to think of T cells and B cells is as follows: B cells have one property that is essential. They can mature and differentiate into plasma cells that produce a protein called an antibody. This protein is specifically targeted to a particular antigen. However, B cells alone are not good at making antibodies, and rely on T cells to signal that they should begin maturation. When a properly informed B cell recognizes the antigen it is coded to respond to, it divides and produces many plasma cells. The plasma cells then secrete large numbers of antibodies, which fight specific antigens circulating in the blood.

T cells are activated when a particular phagocyte known as an antigen-presenting cell (APC) displays the antigen to which the T cell is specific. This blended cell (mostly human, but displaying an antigen to the T cell) is a trigger for the various elements of the specific immune response.

A subtype of T cell known as a T helper cell performs many roles. T helper cells release chemicals to

- Help activate B cells to divide into plasma cells
- Call in phagocytes to destroy microbes
- Activate killer T cells

Once activated, killer T cells recognize infected body cells and destroy them.

Regulatory T cells (also called suppressor T cells) help control the immune response. They recognize when a threat has been contained, and then send signals to stop the attack.

The cells that make up the specific immune response circulate in the blood, but they are also found in various organs. Within the organ, immune tissues allow for maturation of immune cells, trap pathogens, and provide a place where immune cells can interact and mount a specific response. Organs and tissues involved in the immune system include the thymus, bone marrow, lymph nodes, spleen, appendix, tonsils, and Peyer's patches (in the small intestine). Infection occurs when a pathogen invades body cells and reproduces. Infection usually leads to an immune response. If the response is quick and effective, the infection will be eliminated or contained so quickly that the disease will not occur.

Sometimes infection leads to disease. (Here we will focus on infectious disease, and define it as a state of infection marked by symptoms or evidence of illness.) Disease can occur when immunity is low or impaired, when virulence of the pathogen (its ability to damage host cells) is high, and when the number of pathogens in the body is great.

Depending on the infectious disease, symptoms can vary greatly. Fever is a common response to infection: a higher body temperature can heighten the immune response and provide a hostile environment for pathogens. Inflammation, or swelling caused by an increase in fluid in the infected area, is a sign that white blood cells are on the attack and release substances involved in the immune response.

Vaccination works to stimulate a specific immune response that will create memory B and T cells specific to a certain pathogen. These memory cells persist in the body and can lead to a quick and effective response if the body encounters the pathogen again.

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