

Unit 1 - General concepts in immunology

General concepts in immunology

Immunology is the study of the immune system and its responses to invading pathogens. The immune system includes the molecules, cells, tissues, and organs that are associated with immunity in the host defense mechanisms. The coordinated reaction of these cells and molecules to invading pathogen is called immune response. The organs of the immune system are positioned throughout the body. They are called lymphoid organs. The generation of an immune response of either the innate or acquired variety requires the interaction of specific molecules, cells, and tissues.

The immune system of fish is almost similar to that of higher vertebrates. Immunity is referred as the state of acquired or innate resistance or protection from a pathogenic microorganism or its products or from the effect of toxic substances. The cells of the immune system consist of lymphocytes, specialized cells that capture and display microbial antigens, and effector cells that eliminate pathogens.

Microorganisms in the environment are blocked by physical barriers like skin, mucus etc from being enter into the host. If the pathogens overcome this barrier and invade the host the innate immune mechanism is activated and destroys the pathogen. If the pathogen survives the innate immunity the adaptive immunity is activated and combats the pathogen, added to it adaptive immunity also keeps the memory of the pathogen which helps the immune system during the secondary invasion of the same pathogen.

Host defense mechanisms consist of innate immunity and adaptive immunity. Nonspecific immunity is a fundamental defence mechanism in fish. Non specific immunity also plays a key role in activating acquired immune response.

Innate immunity

Innate immunity also called natural or native immunity, takes part in the initial protection against Pathogens. Innate immunity in healthy host is prepared to block the entry of microbes and to rapidly destroy pathogens that enter into host tissues.

Innate immunity acts non specifically where the nature or quality of the reaction to a foreign substance does not change when the organism encounters repeatedly.

Innate immunity does not discriminate between the pathogens. The mechanisms of innate immunity provide the initial defense against infections. Majority of the microbes are blocked by physical barrier. If the pathogens succeed in entering the host then these pathogens are eliminated by phagocytes, NK cells, complement system etc.

There are two types of innate immunity

- Humoral immunity and
- Cell-mediated immunity

Humoral immunity

Humoral immunity is mediated by the antimicrobial peptides, cytokines etc where the cellular substance are involved.

Cell-mediated immunity

Cell-mediated immunity is mediated by the non specific immune cells like macrophages, NK cells, granular cells etc.

Adaptive immunity

Adaptive immunity also called specific or acquired immunity develops more slowly and take part after innate immunity, adaptive immunity is even more effective against pathogens.

Adaptive immunity is stimulated by the presence of pathogens.

If the pathogen survives the innate immunity, adaptive immunity develops later and mediated by lymphocytes and their products. Where antibodies block infections and eliminate pathogens, T lymphocytes also helps in eradicating intracellular microbes.

There are two types of adaptive immunity

- Humoral immunity and
- Cell-mediated immunity

Humoral immunity

Humoral immunity is mediated by the antibodies which are immunoglobulins and these immunoglobulins are produced by plasma cells differentiated from B cells.

Antibodies are formed against antigens, secreted into the blood and mucosal fluids so these antibodies can neutralize and eliminate pathogens and microbial toxins that are harmful to host.

Cell-mediated immunity

Cell-mediated immunity is mediated by different immune cells that are formed to provide protection against pathogen.

Antibodies cannot reach the pathogen that divide inside infected cells. Defense against such intracellular pathogens is mediated by cell mediated immunity. Cell mediated immunity is mainly through T lymphocytes. Here a type of T lymphocyte, stimulates the phagocytes to quickly recognize the pathogen and destroy them. Other T lymphocytes kill any type of host cells that are harboring infectious microbes in their cytoplasm.

Adaptive immunity may be sub-divided into two major types depending on how the immunity was introduced.

Naturally acquired immunity occurs through contact with a pathogen in environment, whereas artificially acquired immunity develops with vaccination.

Both naturally and artificially acquired immunity can be further subdivided depending on whether immunity is induced in the host or passively transferred from an immune host. Passive immunity is acquired through transfer of antibodies or activated T-cells from an actively immunized host, passive immunity may last only a few months, whereas active immunity is induced in the host by vaccination, and lasts longer duration may be life-long. An individual exposed to an antigen of a microbe develops an active immune response to eradicate the infection and develops resistance to later infection by that microbe. Such an individual is said to be immune to that microbe.

The most important properties of adaptive immunity is the fine specificity for antigens and memory to the prior exposed antigen.

The tissue of the immune system consist of primary lymphoid organs, in which T and B lymphocytes mature and become competent to respond to antigens, and the peripheral or secondary lymphoid organs, in which adaptive immune response to microbes are initiated.