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Medical Biology

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Immunity(resistance):is the body's defense against infectious organisms and other invaders, through a series of steps called the **immune response**. On other words, the ability of an organism to resist infectious disease, it's the sum of all naturally occurring defense mechanisms that protect humans from diseases. **The immune system**, which is made up of special cells, proteins, tissues, and organs, defends people against invaders , keeping people healthy and preventing infections.

There are two types of resistance

1-Non-specific (innate)
2-Specific (acquired)

Non-specific immunity, as the name suggests, is not specific to a certain group of micro-organisms. These defense mechanisms act against each and every invader of the body.

Anatomical barriers include physical, chemical and biological barriers.

Skin is the first barrier and the first mechanism of non-specific defense. The epithelial surfaces form a physical barrier that is impermeable to most infectious agents, acting as the first line of defense against invading organisms.

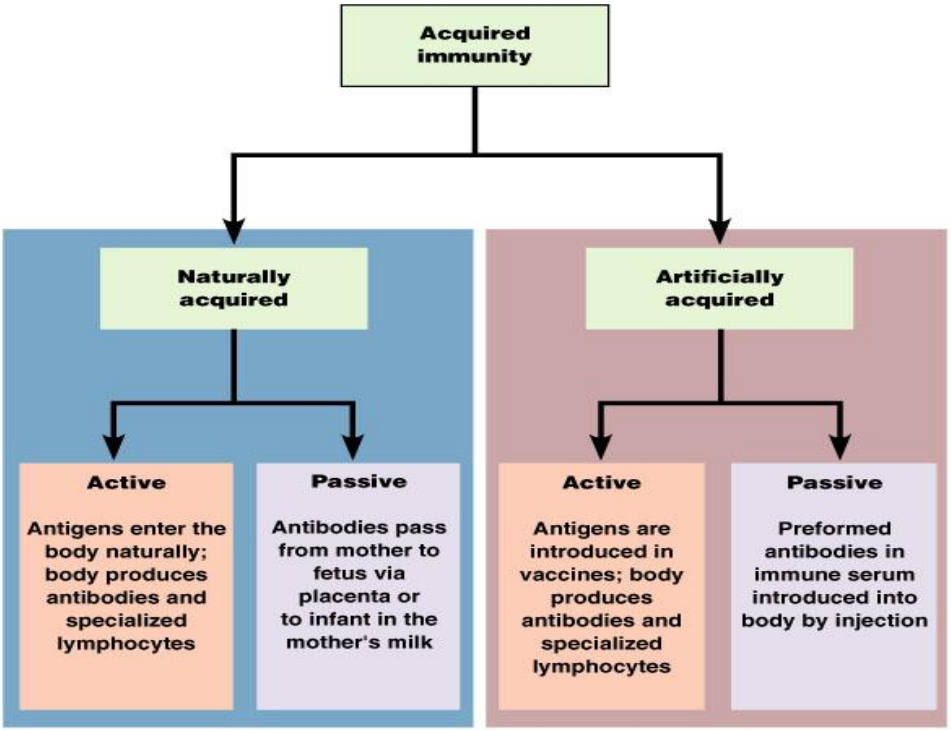
Desquamation of skin epithelium also helps remove bacteria and other infectious agents that have adhered to the epithelial surfaces. presence of sebaceous glands in the dermis provides an environment unsuitable for the survival of microbes. presence of sweat glands that secrete sweat which washes infections off(High salt content of sweat dries micro-organisms off)

The flushing action of tears and saliva helps prevent infection of the eyes and mouth. Saliva contains anti-bacterial properties due to lysozymes.

In the gastrointestinal and respiratory tract, movement due to peristalsis or cilia, respectively, helps remove infectious agents. Also, mucus traps infectious agents. The gut flora can prevent the colonization of pathogenic bacteria by secreting toxic substances or by competing with pathogenic bacteria for nutrients or attachment to cell surfaces. Some epithelia produce mucus which also acts as a barrier against infections. If

micro-organisms penetrate these defense systems they meet the second line of defense including phagocytic white blood cells , antimicrobial proteins and inflammatory response

Specific immunity (Adaptive Immunity) : immunity that an organism develops during lifetime result of exposure to antigens(microbes, toxin or other foreign substances) it's the second line of defense involves production of antibodies and generation specialized lymphocytes against specific antigens. Specific immune response occurs in two separate occasions:



The difference between Specific and Nonspecific Immunity

	Non-specific immunity	Specific immunity
1	Is a set of defenses effective against all the invaders	is a highly focused and targeted response
2	is the first line of defense	is the second line of defense
3	includes effector cells like white blood cells and macrophages	includes cells like lymphocytes, antigen presenting cells, and memory cells
4	does not form a defensive memory	form a defensive memory

Immune responses to antigens may be categorized as primary or secondary responses

A-Primary response

Imagine a person is never exposed to a particular immunogen(antigen). For the first time in his life one antigen enters into his body This leads to a relatively week, short-lived immune responses called Primary immune responses. The primary immune responses can be divisible into four phases (lag phase, exponential phase, steady state phase, and declining phase)

a. The lag (latent) phase is the period from the initial exposure of immunogen to the time of detection of antibodies (In humans the average time of lag phase is about one week). During this lag phase specific T cells and B cells are activated by their contact with immunogen.

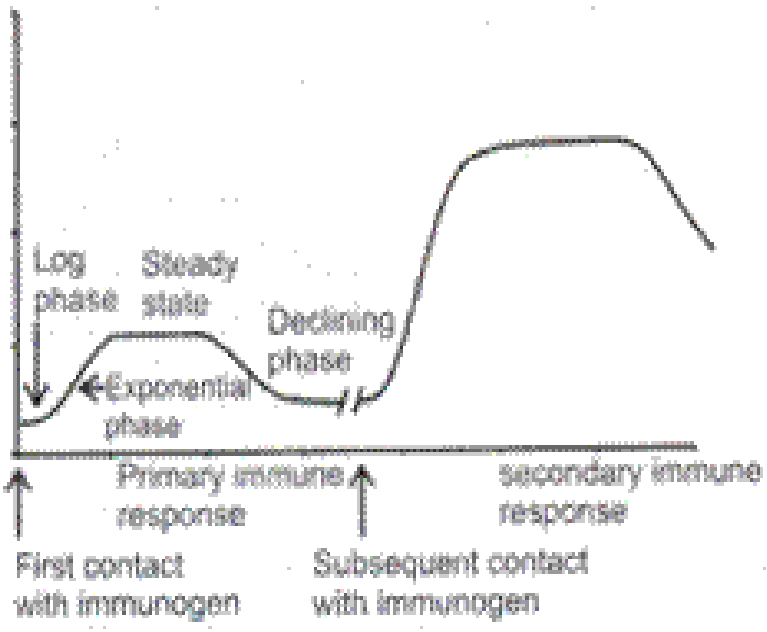
b. The exponential phase is the period during which there is a rapid increase in antibody levels due to secretion of antibodies by many plasma cells.

c. steady state phase (plateau phase): The antibody level remains relatively at a constant level because the secretion and degradation of antibodies occur almost at equal rates.

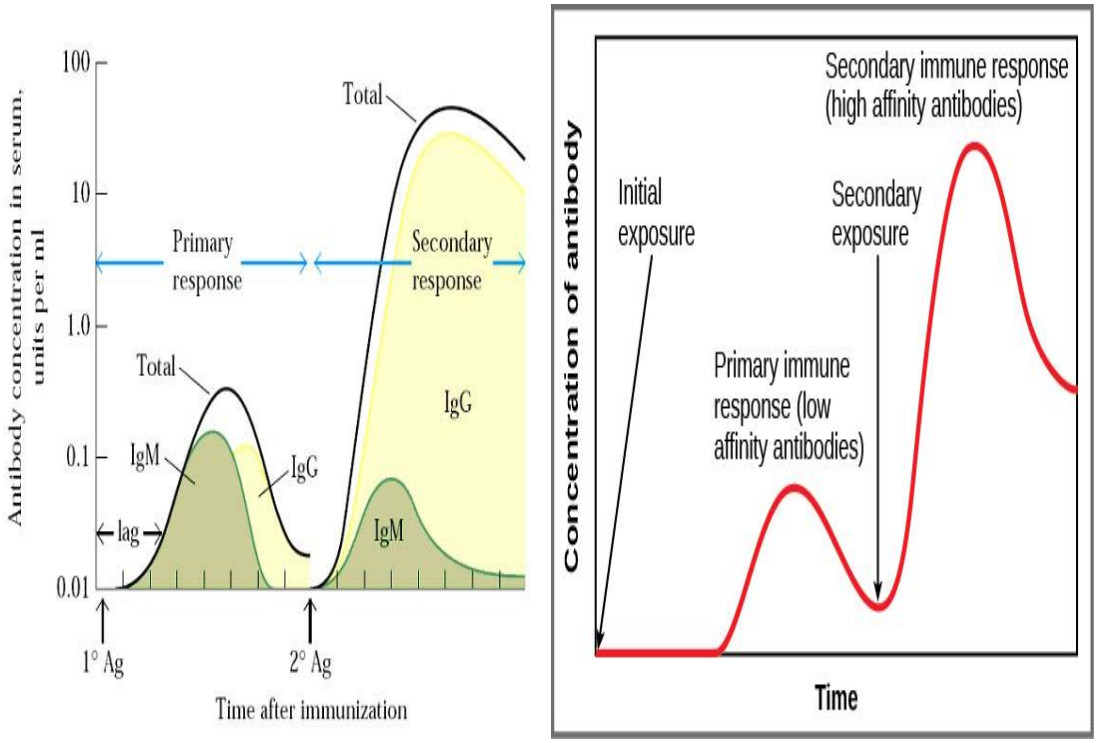
d. declining phase: The antibody level gradually declines because new plasma cells are no longer produced and the existing plasma cells are dying. This generally indicates that the immunogen has been eliminated from the body and consequently there is no stimulus for continued antibody production.

B-Secondary response

When a similar antigen enters the host for the second and subsequent times, the immune responses induced are called secondary immune responses. During secondary immune responses the lag period is shortened and antibody level reaches a very high steady state level within few days. Since the secondary immune responses are induced rapidly (within a short time after the entry of the antigen) to greater levels, the antigen is eliminated before it can cause damage or disease. More over the antibodies remain in circulation for a longer period. Since specific memory T and B cells for the immunogen have already been produced during the primary response, the lag phase is shorter when compared to the primary immune response



Primary and secondary immune responses



Primary and secondary response

Difference Between Primary Response and Secondary Response.

	Primary Response	Secondary Response
Exposure to antigen	first exposure to a specific antigen	*after second exposure to the same a*ntigen
Time of onset	1-week delay	Within hours
Strength	weak potency	more potent
Duration	Short life , for only a few weeks	forms antibodies for many months
Type of antibody	IgM	IgG

There are two main ways to destroy a pathogen:-

Humeral immunity, for which the protective function of immunization could be found in the humor (fluid or serum) .

cellular immunity, for which the protective function of immunization was associated with cell

Cell -mediated immunity

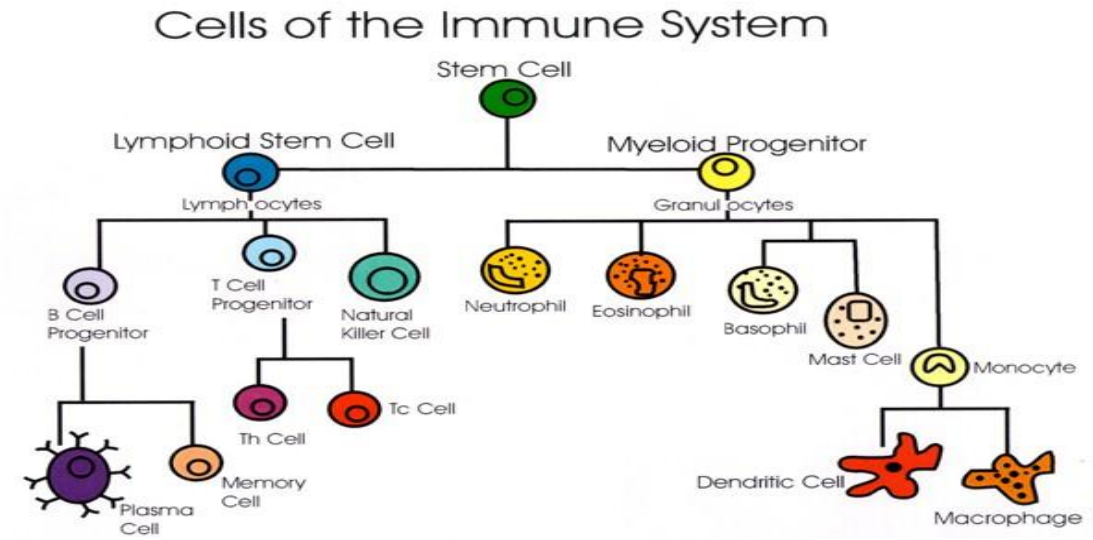
Is an immune response that does not involve antibodies, but rather involves the activation of phagocytes, antigen-specific cytotoxic T-lymphocytes, and the release of various cytokines in response to an antigen. Cell-mediated immunity is directed primarily at microbes that survive in phagocytes and microbes that infect non-phagocytic cells. It is most effective in removing virus-infected cells, but also participates in defending against fungi, protozoans, cancers, and intracellular bacteria. It also plays a major role in transplant rejection.

Cellular immunity protects the body by:

-activating antigen-specific cytotoxic T-lymphocytes that are able to induce apoptosis in body cells displaying epitopes of foreign antigen on their surface, such as virus-infected cells, cells with intracellular bacteria, and cancer cells displaying tumor antigens.

-activating macrophages and natural killer cells, enabling them to destroy pathogens.

-stimulating cells to secrete a variety of cytokines that influence the function of other cells involved in adaptive immune responses and innate immune responses



Humeral Immunity

involves a cellular macromolecules which are dispersed in the body's fluids. So living cells do not act directly on the pathogen. The immune cells indirectly attack the pathogen by making a cellular molecules which directly affect the pathogen. There are many molecules like complement that fall under this category, but usually when Humeral Immunity is mentioned it is referring to antibodies. Antibodies are molecules released by B cells that act directly on the target pathogen. Humeral Immunity primarily targets extracellular pathogens like bacteria.

complement system

The complement system is a part of the immune system that helps or complement the ability of antibodies and phagocytic cells to clear pathogens from an organism. It is part of the innate immune system, which is not adaptable and does not change over the course of an individual's lifetime. However, it can be recruited and brought into action by the adaptive immune system

The complement system consists of a number of proteins(35) found in the blood, in general synthesized by the liver, and normally circulating as inactive precursors 12 of them are essential and called by giving the letter C followed by a number C1,C2,C3 ….. When an antigen associated with one of the complement proteins lead to change the composition , turning him into an effective form, and the latter does the second protein , which does third protein ... and so on in a series of reactions , to be formed in the end compound membrane attack complex(C5-C9) capable of attacking the pathogen and killing the cell by cytolysis.

Function of complements

The following are the basic functions of complement

Opsonization – enhancing phagocytosis of antigens

Chemotaxis – attracting macrophages and neutrophils

Cell Lysis – rupturing membranes of foreign cells

Agglutination – clustering and binding of pathogens together (sticking)

Complements activation

1-Classical Pathway

2-Alternative Pathway

3-Lectin Pathway