

## Chapter - 39

# Immune System

In the life of all, sometimes there are infections of disease causing agents such as bacteria, viruses, fungi and parasite animals. We all have a system in body to prevent these disease causing factors. This system is called **Immune System**. This system protect us from the infection caused by disease causing factors. If this mechanism works in a defective manner or the factors causing disease are escape from this, then disease causing infection agents begin to do their work, as a result of it, our body become infected by disease.

### Immunity

It may be defined as “The ability of the body to identified the foreign substances and makes them ineffective, eliminates or metabolizes with or without harming body tissue”.

### Immunology

The term immunity is derived from the latin word Immunis It means free of burden or ability to provide safety against the various disease causing factors. The study of this is known as **immunology** . It includes the study of various components of immune system and its working system. The immune system gives immunity towards the disease.

### Concept of Self and Non-Self

Our body is able to recognize the self and non self molecule, to wit it stimulate the immune system to take out all those substance from body which are foreigner factors so that those external factors can be destroyed from the body.

But, If any organ in any person gets damaged and organ transplant from other person is done then it recognizes that transplanted organ and performs immune response on that organ.

### Type of Immunity

Immunity is of two types : (I) Natural or Innate immunity (II) Acquired Immunity

#### (I) Natural Immunity

A person protect himself from different harmful and disease causing micro-organism by different types of effective processes. These processes are called **natural or innate immunity**. This immunity is genetic. It is present since birth and obtained by barriers which prevents the entry of disease causing factors into body.

In this type of immunity or barrier capacity mainly has four types of factors -

**(1) Physical barrier-** This first prevents the micro-organism causing the disease to enter the body. So this is first defense line.

In this, the following organ participate :-

**(I) Skin-** There are two distinct layers are found in skin (a) A thin and outer layer Epidermis, and (b) A thick and inner layer Dermis. Epidermis is made up of many layers of epithelial cells. It's outer most epidermal layer is made up of dead cells. This tough layer is made up of hydrophobic keratin protein, which can't be penetrated by pathogens. Inner layer dermis is made up of connective tissue in which blood vessels, hair follicles, fat glands and

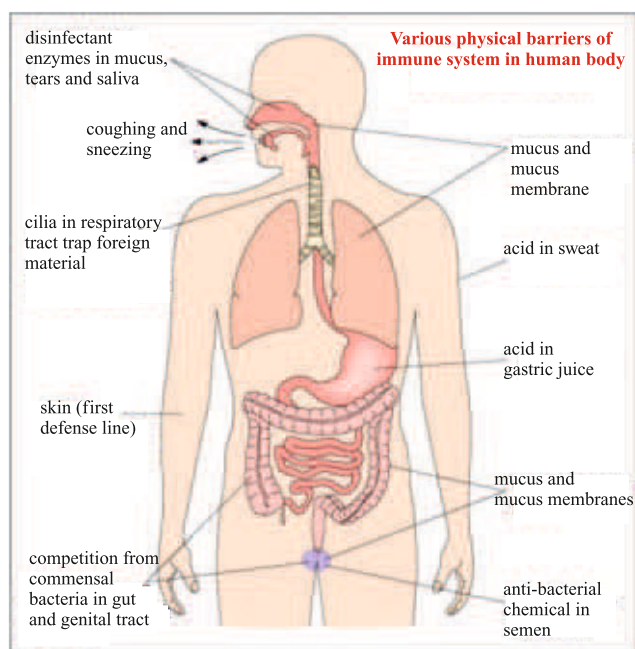


Fig. 39.1 Various physical barriers of immune system in human body

sweat glands are included.

Fat glands are attached with the hair follicle and they make an oily secretion called sebum. Sebum has lactic acid and fatty acid. These acids maintain the pH between 3 to 5 of the skin. Many of the micro organisms do not grow at this low pH. Intact skin prevent the entry of pathogens and its low pH prevent the growth of most bacteria. On a small cut in the skin pathogen enter and they causes infection in the body. Along with this, pathogens can enter through bites of various insect and they grip the body from diseases.

**(ii) Mucous Membrane-** There is a layer of epithelium in the path of various organs of respiratory system, digestive system and Urino genital system. This layer is covered by a protective mucous layer. If any pathogen come in this path, then it get stuck in the mucous membrane. Continuous renewal of the epithelial layer continues, which also leads to expulsion of stucked germs in its mucous membrane. In the tract of respiratory system, cilia are found on the epithelial layer. These cilia move upward continuously toward naso pharynx and thus they carry out the bacteria and other particles that cause the disease. Besides this, on the epithelial cells of the mucous

membrane, there are many bacteria present which are useful. The bacteria found in normal state have competition with disease causing bacteria due to which they do not connect with this cells. In the mucous membrane there is an enzyme lysozyme is also present which kills the bacteria.

**(iii) Physiological barriers -** Different parts of body release different types of secretion. They give away disease causing agents or bacteria. There are various type of enzymes found in the sweat and eyes secretion that break the cell wall of the bacteria and destroy them. In other body liquids also have such molecules that are bactericidal which are capable to kill the bacteria. Such as spermine and zinc in seminal fluid, HCL acid in gastric juice, lactoperoxidase in milk, lysozyme enzyme in tear, saliva and nasal secretions.

If the bacteria enter in the body then other two immunity process start their functions. First the soluble **chemical factors** start their bactericidal effect which is called **complement system** and second by phagocytosis they are killed.

## (2) Complement system -

Complement system is a group of more than 30 proteins. Components of some complement system are represented by letter 'C' and with this it is displayed by the number. The number written in it represent the sequence of its discovery. Out of these the most important and the commonly found component is  $C_3$ .

These protein components are found in plasma fluid and on the surface of cell. This system along with the protein system of clotting and fibrinolysis there is also a system of protein found in the blood plasma. In this, a protein activates or dissociate into a product that act as catalyst for the other protein. Thus, many active or dissociated proteins perform many immune work in body.

This system makes pore in the cell membrane of micro-organism. Some complement components make a envelope around the micro-organism. This envelope attracts the phagocytes (neutrophils and macrophages) to this place. These phagocytes come here and swallow these micro-organism and destroy

them. This is why the complement system is an important component of natural or innate immunity.

### (3) Cellular Phagocytic Barrier

Different specific cells present in the body work as phagocytes such as monocytes, neutrophils and macrophages. When micro-organism or inactive particles such as colloidal carbon, reach in the tissue fluid or blood flow then they are swallowed and destroyed by these phagocyte cells. These cells are either circulated in the body fluids or get binds in some tissue and perform of phagocytosis.

### (4) Inflammatory Barrier/Cytokine Barrier

The various tissue of body in which wound developed due to injury or damaged cells due to infection of pathogens, at that spot appearance of red colour, pain and heat is generated. These different complex and sequence wise processes are collectively called inflammatory processes. In this, mast cells of connective tissue and basophil cells of white blood corpuscles, secrete histamine and prostaglandin as chemical warning which generate inflammation. Due to spreading these, the blood capillaries become more permeable. Plasma and phagocytes come out of the capillaries and do the work. The serum proteins present in plasma also have the bactericidal properties. Accumulation of these at a location, generate inflammation. Phagocytes destroy the micro-organism that enter into the body.

## II. Acquired Immunity

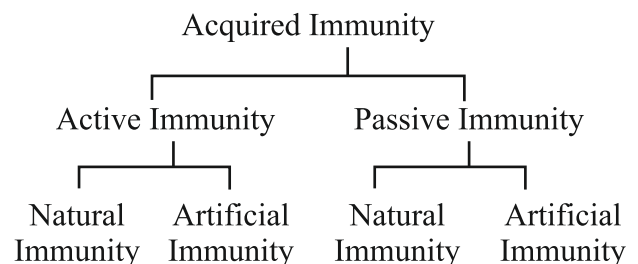
This immunity is obtained during the life time. This is developed by the organism on the basis of former memory power of micro-organism or the metabolic substances produced by them. It develops in the form of resistivity of the disease during the life span of the organism. In this immunity, specific antibodies and cells are formed against micro-organism and protection from micro-organism is done. This immunity is of two types :-

**Acquired Immunity-** This immunity is antigen specific. Its main property is memory. When disease causing factor entered into body for the first time, then it showing the reaction of immune system

by producing antibodies is called primary response. During this process memory cells are produced. Thus, the same disease causing factor enter into the body again, then the immune system produces excess of antibodies with the help of former memory cells and responds rapidly. This is called secondary immune response.

Acquired immunity is of two types :-

1. Active immunity
2. Passive immunity



**Active Immunity** – When disease causing organism or antigen enter into the body and antibodies are formed then this type of immunity is called **active immunity**. This immunity is slow and takes time to become effective but its effect remains for long periods. The natural active immunity is developed when infectious organism enter into body by natural infection while, when disease causing organism or antigen is intentionally introduced in the body by vaccination then artificial active immunity is developed.

**Passive Immunity**– When the preformed antibodies are introduced into body for the protection then passive immunity is obtained. This immunity develops rapidly but remain effective for a short duration. During pregnancy, the embryo gets IgG through placenta and during lactation the mother provides the new born child IgA through colostrum which are example of passive immunity. The antivenom/antitoxin given in the treatment of snake bite or dangerous disease such as tetanus, rabies, diphtheria, produce the artificial passive immunity.

**Auto Immunity**– There is a capacity of differentiating between self and the cells of

heterogeneous organism in the acquired immunity. It means this immunity develop antibodies only against heterogenous organism. But at some times, due to heredity, environment or other reasons this immunity makes antibodies against self cells and attacks on these cells. This type of immunity is called **auto immunity** and the disease resulting from auto immunity is called **auto immune disease**.  
i.e. **Rheumatoid arthritis**

**Vaccination (Active Immunization)** – Long ago, people observed that people who once become infected with any disease and become healthy, they do not suffer that disease again. By this the concept of vaccination was developed. In vaccination, any non virulent or killed or attenuated or inactive micro-organism or toxins produced by them are injected in the body in a very minute quantity that is called **vaccine** and this process is called vaccination. By this, the body produces memory cells in specific population. These memory cells increase rapidly in the number and produces a large number of antibodies against the infection of same antigen again and protect the body from disease. For the first time Edward Jenner in 1796 used the cow pox vaccine on a boy named James Fipps for pox. He is known as father of vaccination because of his contribution.

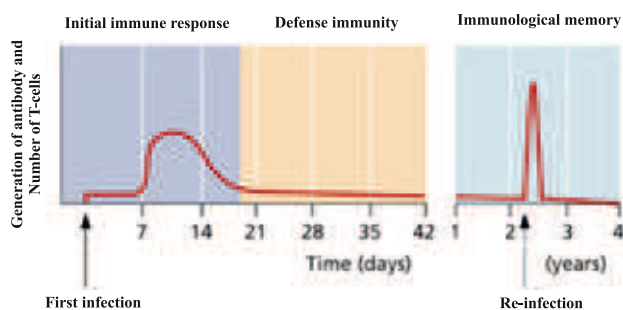


Fig. 39.2 Defense immunity response by vaccination

## Type of Vaccine –

Following types of vaccine are used –

### (i) Live, Diluted and Attenuated Vaccines –

In order to make living attenuated vaccine, pathogenic virus is cultured by tissue culture or cultured in animal embryo such as chick embryo for

many generations. Due to which replication properties in human is eliminated. But this virus can be detected by the human immune system. i.e. – Rubella, measles, rota virus and oral polio etc.

### (ii) Killed or Inactivated Organism Vaccine

– This type of vaccines are created by deactivating of a pathogen. For this, usually the pathogenic factor is heated or treated with chemicals such as formaldehyde or phosphorin to destroy their division capacity but the antigen properties of pathogen are preserved so that the immune system can identify it.

For example– typhoid, cholera, rabies, whooping cough, hepatitis and polio injection etc.

### (iii) Toxoid Vaccine –

Some bacterial diseases are not caused by bacteria directly, but they are caused by toxins produced by them. One example of this is – tetanus. The symptoms of this are not because of *Clostridiumtetany* bacteria but it is because of neurotoxin-**tetanospasmin** secreted by them. it causes **tetanus disease**. So, to prevent it toxoid vaccines is used. The toxoid vaccine is made by physical and chemical refining process of toxins to make them harmless but its immunogenicity is maintained. For example – diphtheria, tetanus etc.

### (iv) Conjugate and Unit Vaccines –

Conjugate vaccines are like recombinant vaccines. They are made from two separate components by combining them. In this, the piece of bacterial coat is used. This coat is attached to the carrier protein chemically. This combination is used as vaccine. In unit vaccine, only one portion of target pathogen is used for the stimulation of immune response by immune system. In this, a specific protein is isolated from specific pathogen and it is introduced into body as an antigen.

Acellularpertusis vaccine and influenza vaccines are examples of unit vaccine

### (v) Engineered Vaccine –

The production of vaccines at a large scale is done with the help of recombination technique in which the antigen of the pathogen is produced in yeast or bacteria i.e. – hepatitis vaccine



## Important Points

1. The immune system protect our body from the infections of pathogens. In human body, many types of immun system are found.
  2. Immune system is a complex system of the cells, tissues and soluble substances which work in co-ordination.
  3. Immune activities are of two types specific and non specific.
  4. Specific immunity processes are either cell mediated or antibody mediated, humoral immunity.
  5. In human body there are five types of antibodies or immunoglobulins are present in which IgG is present in highest concentration.
  6. Thymus or bone marrow are central or primary or main lymph organs.
  7. Lymphocytes which are main immune cells are of two types –  
B – lymphocytes, T – lymphocytes
  8. B – cells modified into plasma cells which produced antibodies.
  9. Foreign molecule or non self molecule which start the immune response is called antigen.
  10. Immunity is of two types – Natural or innate and Acquired.
  11. Vaccination is a type of immunity obtained in active from.
  12. Vaccines are of three types –
    - Dead organisms used in the form of vaccines.
    - Live, diluted or attenuated organism used as vaccines.
    - Toxoid vaccines.
- (c) T – lymphocytes      (d) Thrombocytes
  2. Antibody molecules are -
    - (a) Sugar                      (b) Aromatic
    - (c) Nucleic Acid              (d) Protein
  3. Which antibody contributes in allergy response?
    - (a) IgG                          (b) IgA
    - (c) IgE                          (d) IgM
  4. Which antibody is transferred from mother to embryo through placenta?
    - (a) IgG                          (b) IgA
    - (c) IgE                          (d) IgM
  5. What is formed in human body as a result of vaccination?
    - (a) Plasma                      (b) Histamin
    - (c) Antibody                      (d) Toxoid

## Very Short Answer Questions -

1. Name the part of antigen that combines with antibody.
2. How many types of immunity and antibodies are present.
3. Mention the name of antibody found in highest concentration.
4. Which type of immune response is responsible for destroying the tumor cells? tell the name.
5. Tell the name of vaccine made from dead cells.
6. Who is known as father of Immunology?

## Short Answer Questions -

1. Write the definition of antibody.
2. Which are the main physical barrier?
3. Mention the main differences between passive acquired immunity and active acquired immunity.
4. Explain about humoral immunity.
5. Mention about T-cells.

## Essay Type Questions -

1. Describe the different cells of immune system.
2. Define the immune system. Explain its different types.

## Practice Questions

### Multiple Choice Questions -

1. In the human body which cells contributes in the cell mediated immunity?
  - (a) Erythrocytes              (b) Mast cells

3. Define the vaccination and describe the different type of vaccines.

**Answer Key –**

- |        |        |        |
|--------|--------|--------|
| 1. (c) | 2. (d) | 3. (c) |
| 4. (a) | 5. (c) |        |