

Resistance of the body against the pathogenic agents is known as immunity. It is the ability of the body to resist the entry of different types of foreign bodies like bacteria, virus, toxic substances etc.

Immunity is of two types :-

- (i) Innate immunity (ii) Acquired Immunity.

Innate immunity

It is also called natural immunity or non-specific immunity. It is present from birth and it is the inborn capacity of the body to resist the entry of micro-organisms into the body. This type of immunity represents the first line of defense against any pathogen. The mechanisms involved in this type of immunity are:-

1. Activities of WBCs and tissue macrophages which destroy the foreign bodies by means of phagocytosis.
2. The enzymes of GI tract and acid in the stomach, which destroy the toxic substances or organisms entering digestive tract through food.
3. Protective function of keratinized stratum corneum of skin against bacteria or other organisms.
4. Lysozyme and some polypeptides, which destroy bacteria.
5. Presence of Peyer's patches and solitary lymphoid follicles protect intestines from any infection.

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Acquired Immunity:-

It is the resistance developed in the body against any specific foreign body like bacteria, viruses, toxins, vaccines or transplanted tissue. So this type of immunity is also known as specific immunity. It is the most powerful immune mechanism that protects the body from the invading organisms. Lymphocytes are responsible for acquired immunity.

Acquired immunity developed by the entrance of any foreign body or vaccine is called active immunity and the acquired immunity developed in non-immune individual by transfer of blood, serum, lymphocytes or antibodies from an immune individual is called passive immunity.

Types of Acquired Immunity:-

Two types of acquired immunity are developed in the body:-

- 1) Cellular Immunity
2. Humoral Immunity.

Development and Processing of lymphocytes:-

In fetus, lymphocytes develop from bone marrow. All the lymphocytes are released in the circulation and are differentiated into two categories:-

- 1) Some lymphocytes migrate to Thymus gland and are transformed into T lymphocytes which develop cellular immunity.
- 2) Some lymphocytes move to liver and bone marrow and are transformed into B-lymphocytes and develop humoral immunity.

1. Lymphocytes:- These are processed in thymus gland under the influence of hormone thymosin secreted by the thymus gland. During the processing, T lymphocytes are transformed into 4 types:-

- 1) Helper T cells or inducer T cells.
- 2) Cytotoxic T cells or killer T cells.
- 3) Suppressor T cells.
- 4) Memory T cells.

After the transformation, the various types of T lymphocytes leave the thymus, migrate and are stored in the lymphoid tissue of lymph nodes, spleen, bone marrow and the GI tract.

* B lymphocytes:-

B lymphocytes are processed in bone marrow and liver and after processing, these are transformed into two types:

- 1) Plasma cells.
- 2) Memory cells.

After the transformation, B lymphocytes migrate and are stored in the lymphoid tissues of lymph nodes, spleen, bone marrow and the GI tract.

CELLULAR IMMUNITY

It is that immunity which is provided by the activation of T lymphocytes. It is also called the cell mediated immunity or T cell immunity because the T cells encounter and destroy the organisms which enter the body. It is the major defense mechanism against infections by viruses, fungi and few bacteria.

For the development of cell mediated immunity T cells come in contact with the antigens. But the antigens or antigenic material is presented to the T cells esp. T Helper cells with the help of the Antigen Presenting cells which are Macrophages and Dendritic cells. These macrophages and Dendritic cells The events which occur during the development of Cellular immunity are as:-

- 1) When the foreign organisms invade the body, the macrophages and other antigen presenting cells engulf them by phagocytosis.
- 2) Helper T cells recognizes the antigen bound to the antigen presenting cell.
- 3) The recognition of the antigen by the helper T cells causes activation of helper T cells.
- 4) The activated helper T cells proliferate and secrete some chemicals called interleukins which activate other types of T cells and B cells.
- 5) Activated Cytotoxic T cells release cytotoxic substances which destroy the invading organisms.
- 6) Activated Suppressor T cells (also called regulatory cells) suppress the activities of the killer T cells. These suppressor T cells play an important role in preventing killer T cells from destroying the body's own tissues along with invaded organisms.

4) Activated memory T cells migrate to the various lymphoid tissues throughout the body. When the body is exposed to the same organism for the second time, the memory cells identify the organisms and immediately activate the other T cells.

5) The activated B cells proliferate into plasma cells and produce antibodies which provide extra immunity.

HUMORAL IMMUNITY

It is that immunity which is provided by the activation of B lymphocytes. It is also called B cell immunity.

B lymphocytes fight against the invading organisms by secreting antibodies into the blood and lymph. Since blood and lymph are the body humors, i.e.,

why this immunity is called humoral immunity. This immunity is the major defensive mechanism against bacterial infection. Events which take place in humoral immunity are as follows:-

- 1) The antigen presenting cells recognise the invading organism and phagocytose it.
- 2) B cells recognise the antigen bound to APC.
- 3) B cells get activated and proliferate into two types of cells i.e., plasma cells and memory cells.
- 4) The plasma cells produce antibodies and are released into blood and lymph and neutralize the antigens.

- 5) Memory cells are stored in the lymphoid tissue. These get activated when the body is exposed to the same organism for the second time and produce more quantity of antibodies at a faster rate.

ANTIGENS

→ The antigens are the substances which induce specific immune reaction in the body. Antigens are of two types:

- A) Autoantigens: Also called self antigens are those antigens which are present on the body's own cells eg; A and B antigens on the surface of RBCs.
- B) Foreign antigens: Also called non-self antigens are those antigens which enter the body from outside. Examples of non-self antigens are bacteria, viruses, fungi, toxins of microbes, materials from transplanted organs or incompatible blood cells, pollen grains etc.

ANTIBODIES:-

An antibody also known as immunoglobulin is a large Y-shaped protein produced by plasma cells in response to the presence of antigens. Once antibodies are formed, they recognise, neutralize and destroy the antigens. Antibodies are actually formed from the B lymphocytes which when recognise the antigens get transformed into plasma cells and plasma cells produce antibodies. In general there are 5 types of

antibodies which have common basic structure.

Structure of Antibodies:-

Antibodies are proteins (gamma globulins) in nature. Each antibody has two pairs of chains namely one pair of heavy or long chain and one pair of light or short chain. These chains are made up of amino acids.

Each antibody has two equal halves which are identical. The two halves are held together by disulphide (S-S) bonds. Each half of the antibody consists of one heavy chain and one light chain which are held with each other by disulphide bonds. In each antibody, the light chain is parallel to one end of the heavy chain forming one arm of the antibody. The remaining part of heavy chain forms another arm. Both arms are joined at the hinge.

Each chain of the antibody includes two regions:-

- 1) Constant region
- 2) Variable region.

→ Constant region:- The amino acids present in this region are similar in number and sequence in all the antibodies of each type i.e., this region is called the constant region or FC (Fragment crystalline) region. Thus the identification and functions of different types of antibodies depends upon this region.

→ Variable region:- The amino acid number and sequence in this region is different in each type of antibody. So this is called variable region. This region enables

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the antibody to recognise the specific antigen and to bind itself with the antigen. So this region is also called antigen binding region or Fab (Fragment antigen binding) region.

Types and functions of antibodies:-

There are five types of antibodies depending upon the type of heavy chain constant region. The five types of antibodies are:-

- (i) IgA (ii) IgD (iii) IgE (iv) IgG (v) IgM.

Among these antibodies, IgG forms 75% of the antibodies in the body.

- IgA (Ig Alpha) is a divalent antibody or IgA is made up of 2 antibodies. It is commonly distributed in serum, nasal discharge, saliva, breast milk and bowel fluids. Breast milk protects the newborns from bacterial and viral infections (maternal immunity).
- IgD (Ig Delta) is present on the surface of B cells and plays a role in the induction of antibody production and antigen recognition.
- IgE (Ig Epsilon) is involved in allergic reactions of the body and parasitic infections.
- IgG (Ig Gamma) is the main antibody in blood. It is the only antibody that can pass through the placenta and IgG transferred from mother's body to the foetus protects the foetus until a few weeks after birth.

IgM (Ig Mu) is a pentavalent antibody i.e. it is made up of 5 antibodies. IgM has an important role in the initial immune response of the body is its presence in blood denotes the acute stage of illness.

Mechanism of Action of Antibodies:-

The antibodies directly inactivate the invading organisms by any one of the following methods:-

- 1) Agglutination: In this method, the foreign bodies or antigens are held together in a clump by the antibodies.
- 2) Precipitation: In this process, the soluble antigens like tetanus toxoid are converted into insoluble forms and then precipitated.
- 3) Neutralization: In this process, the antibodies cover the toxic sites of antigenic products.
- 4) Lysis: It is done by the most potent antibodies. The antibodies rupture the cell membrane of the organisms and then destroy them.

IMMUNIZATION:

It is the method of preparing the body to fight against a specific disease. It is a technique used to induce the immune resistance of the body to a specific disease. It is done by exposing the individual to an antigen in order to produce antibodies against that antigen.

Immunization is of two types:-

- 1) Passive Immunization
- (II) Active Immunization.

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Passive Immunization:- It is that immunity which is achieved by administration of serum or gamma globulins from a person who is already immunized.

It may be acquired either naturally ~~when transferred~~ or artificially. Passive natural immunity is transferred from mother to the fetus in the form of maternal antibodies (IgG) through placenta. After birth, the IgA antibodies are transferred through breast milk.

Passive artificial immunization is developed by injecting previously prepared antibodies using serum from humans or animals which have been immunized artificially. The serum containing the antibody called anti serum is administered to people who have developed the disease. This type of immunity is useful for providing immediate protection against acute infections like tetanus, measles, diphtheria etc.

Active Immunization:- It is achieved by activating the immune system of the body. The body develops resistance against diseases by producing antibodies following the exposure to antigens. It may be ~~active or~~ natural or artificial.

Active natural immunity involves activation of immune system of the body to produce antibodies.

Active artificial immunization is achieved by administration of vaccines or toxoids. This process is also called vaccination or immunization.

Active