

Unit II

Immunity

1) What is immunity? Explain the types of immunity.

The ability of body to fight the disease causing organisms is called immunity. Everyday our body comes in contact with several pathogens, but only a few results into diseases. The reason is, our body has the ability to release antibodies against these pathogens and protects the body against diseases. This defence mechanism is called immunity.

Types of immunity

- Immunity is of two types – innate immunity and acquired immunity.

- **Innate immunity** – It is present from the time of birth. It is nonspecific. This is activated immediately when the pathogen attacks.

Innate immunity includes certain barriers and defence mechanisms that keep foreign particles out of the body. It is a long-term immunity in which our body produces the antibodies on its own. Our body has few natural barriers to prevent the entry of pathogens.

It consists of 4 kinds of barriers.

- **Physical barriers** – Skin and mucus coating of respiratory, gastrointestinal, and urogenital tract prevent entry of microbes into body.
- **Physiological barriers** – Acid in stomach, saliva in mouth, tears from eyes
- **Cellular barriers** – Blood has leukocytes such as polymorpho nuclear leukocytes, monocytes, etc. and tissue has macrophages which phagocytose the microbes.
- **Cytokine barriers** – Special proteins called interferons are secreted by virus infected cells that prevent the further spread of viral infection.

- **Acquired immunity** – It is acquired, which means that it is produced in response to an encounter with a pathogen based on memory. It is pathogen specific.

- When a pathogen for the first time infects a person, low intensity immune response is generated (primary response).
- When the same pathogen attacks again, intensified immune response is generated, thereby preventing the occurrence of disease (secondary response).
- Acquired immunity involves two types of cells – B lymphocytes and T lymphocytes.
- B lymphocytes – Secrete proteins called antibodies in response to pathogens. Antibodies are specialized proteins with 4 peptide chains (2 light and 2 heavy), hence denoted as H2L2. IgA IgM, IgE, etc. are examples of some of the

antibodies. They generate humoral immune response (found in blood).

○ T lymphocytes – they help B cells to produce antibodies. They generate cell mediated immune response. This response helps the body to differentiate between ‘self’ and ‘non self’ as occurs in case of graft rejection.

2) Difference between active immunity and passive immunity.

● Active Immunity

Active immunity involves the direct response to a foreign antigen within the body. In the case of the acquired or adaptive immune system, the body remembers the pathogens it has encountered in the past. This is a direct result of the active immune system.

Active immunity occurs when we are in contact with the pathogen or its antigen.

Antigens stand for antibody generator. It is with the help of antigens released by the pathogen that our body tackles the pathogen.

So what our body does is, it starts producing antibodies to attack the pathogen based on its antigen. When this happens for the first time, it is called a primary response. Once a body experiences a pathogen for the first time, it keeps a few of the antibodies that attacked the pathogen just in case it attacks for the second time. This is known as natural active immunity.

● Passive immunity

Passive immunity involves the immune response by the antibodies attained from outside the body. The primary response by the body to a pathogen it encounters for the first time is rather feeble, so the first encounter is always a little harsh on the body.

What if we could immunize everyone without the need for them ever getting sick?

Biotechnology has grown tremendously in the last decade or two and now we are capable of manufacturing antibodies for diseases. These ready-made antibodies protect the body even if the body hasn't yet experienced a primary response.

While active immunity may protect us from a disease for a lifetime, passive immunity is the more short term.

Passive immunity develops immediately and our body could begin its attack on the pathogen right away.

There are two types of passive immunity:

- Natural Passive Immunity
- Artificial Passive Immunity

3) How does vaccination help?

- Vaccines are nothing but inactivated pathogens.
- These inactivated pathogens when introduced in the body produce a primary immune response and antibodies are produced against the pathogen.
- Memory B and T cells are produced.
- Now when the pathogen again attacks the person, memory B and

T cells generate a massive immune response and the pathogen is killed.

- A vaccine is made up of the antigens of the pathogen that cause the disease. For eg., the smallpox vaccine contains the antigens of the pathogen causing smallpox disease. When a person is vaccinated with the smallpox vaccine the antibody-producing cells are stimulated that produce smallpox antibodies. Thus, the body is protected against the disease occurring in future.
- Vaccinating pathogenic **microbes** into our body deliberately produces a similar response and is termed as artificially acquired immunity.
- Immunization is a process providing resistant to pathogenic microbes and other infectious diseases by the administration of a vaccine into the body. By immunization, it stimulates the body's immune system to protect against subsequent infection or disease.

4) What are the problems of immune system?

Problems of immune system

- Allergies
 - Exaggerated immune response to certain antigens present in environment
 - Allergens – Substances in response to which allergy is produced
E.g., dust, pollen, etc.
 - Antibodies involved – IgE type
 - During allergic reactions, chemicals such as histamines and serotonin are released.
 - Symptoms – Sneezing, watery eyes, difficulty in breathing, etc.
 - Allergy test – Patient is injected with small doses of allergens to monitor his response.
 - Antihistamines, adrenalins, and steroids may be given so that the symptoms of allergy.
- Autoimmunity
 - In autoimmunity, body generates immune response against its own cells.
 - Reasons – Genetic and other unknown reasons
 - Example – Rheumatoid arthritis is an autoimmune disease.

5) Explain Human immune system.

The purpose of the immune system is to defend itself and keep microorganisms, such as certain bacteria, viruses, and fungi, out of the body, and to destroy any infectious microorganisms that do invade the body. The immune system is made up of a complex and vital network of cells and organs that protect the body from infection.

The organs involved with the immune system are called the lymphoid organs. They affect growth, development, and the release of lymphocytes (a type of white blood cell). The blood vessels and lymphatic vessels are important parts of the lymphoid organs. They carry the lymphocytes to and from different areas in the body. Each lymphoid organ plays a role in the production and activation of lymphocytes.

- Lymphoid organs are of two types – primary lymphoid organs and secondary lymphoid organs.
- Primary lymphoid organs consist of bone marrow and thymus. Here, immature lymphocytes are differentiated to form antigen sensitive lymphocytes.
 - Bone marrow – Here, all blood cells including lymphocytes are produced.
 - Thymus – It is responsible for maturation of T lymphocytes. This lobed organ is situated near the heart and keeps on reducing in size as the age increases.
- Secondary lymphoid organs – Lymphocytes migrate here after attaining maturity. It includes spleen, lymph nodes tonsils, Peyer's patches, and appendix.
 - Spleen – Large bean shaped organ containing lymphocytes and phagocytes, which acts as a filter for blood
 - Lymph nodes – Located at different points throughout the immune system, they trap the antigens present in lymph or tissue fluid, and these antigens cause activation of lymphocytes and generation of immune response.
- MALT (Mucosal associated lymphoid tissue) – Lines major tracts (respiratory, digestive, urogenital, etc); Constitutes 50% of lymphoid tissue in body.

6) Explain innate immunity.

This type of immunity is present in an organism by birth. This is activated immediately when the pathogen attacks.

Innate immunity includes certain barriers and defence mechanisms that keep foreign particles out of the body.

It is a long-term immunity in which our body produces the antibodies on its own. Our body has few natural barriers to prevent the entry of pathogens.

It consists of 4 kinds of barriers.

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○ T lymphocytes – they help B cells to produce antibodies. They generate cell mediated immune response. This response helps the body to differentiate between 'self' and 'non self' as occurs in case of graft rejection.

8) Explain about Allergies.

- The exaggerated response of the immune system to certain antigens present in the environment is called allergy.
- The substances to which such an immune response is produced are called allergens.
- The antibodies produced to these are of IgE type. Common examples of allergens are mites in dust, pollens, animal dander, etc.
- Symptoms of allergic reactions include sneezing, watery eyes, running nose and difficulty in breathing.
- Allergy is due to the release of chemicals like histamine and serotonin from the mast cells.
- For determining the cause of allergy, the patient is exposed to or injected with very small doses of possible allergens, and the reactions studied.
- The use of drugs like anti-histamine, adrenalin and steroids quickly reduce the symptoms of allergy.
- Somehow, modern-day life style has resulted in lowering of immunity and more sensitivity to allergens – more and more children in metro cities of India suffer from allergies and asthma due to sensitivity to the environment.
- This could be because of the protected environment provided early in life.

9) Explain about Cells involved in innate immunity.

□ **Phagocytes:** These circulate through the body and look for any foreign substance. They engulf and destroy it defending the body against that pathogen.

□ **Macrophages:** These have the ability to move across the walls of the circulatory system. They release certain signals as cytokines to recruit other cells at the site of infections.

□ **Mast Cells:** These are important for healing wounds and defence against infections.

□ **Neutrophils:** These contain granules that are toxic in nature and kill any pathogen that comes in contact.

□ Eosinophil's: These contain highly toxic proteins that kill any bacteria or parasite in contact.

□ Basophils: These attack multicellular parasites. Like the mast cells, these release histamine.

□ Natural Killer Cells: These stop the spread of infections by destroying the infected host cells.

□ Dendritic Cells: These are located in the tissues that are the points for initial infections. These cells sense the infection and send the message to the rest of the immune system by antigen presentation.

10) Explain 4 kinds of barriers of innate immunity.

(i) Physical barriers: Skin on our body is the main barrier which prevents entry of the micro-organisms. Mucus coating of the epithelium lining the respiratory, gastrointestinal and urogenital tracts also help in trapping microbes entering our body.

(ii) Physiological barriers: Acid in the stomach, saliva in the mouth, tears from eyes—all prevent microbial growth.

(iii) Cellular barriers: Certain types of leukocytes (WBC) of our body like polymorph-nuclear leukocytes (PMNL-neutrophils) and monocytes and natural killer (type of lymphocytes) in the blood as well as macrophages in tissues can phagocytise and destroy microbes.

(iv) Cytokine barriers: Virus-infected cells secrete proteins called interferons which protect non-infected cells from further viral infection.

11) Features of Acquired Immunity

- Specificity: Our body has the ability to differentiate between different types of pathogens, whether it is harmful or not, and devise ways to destroy them.
- Diversity: Our body can detect vast varieties of pathogens, ranging from protozoa to viruses.
- Differentiate between self and non-self: Our body has the unique ability to differentiate between its own cells and foreign cells. It immediately starts rejecting any foreign cell in the body.
- Memory: Once our body encounters a pathogen, it activates the immune system to destroy it. It also remembers what antibodies were released in response to that pathogen, so that, the next time it enters, a similar procedure is followed by the body to eliminate it.

12) Explain about Lymphoid Organs

- The organs of the immune system which are involved in defending the body against invading pathogens causing infections or spread of tumours is termed as Lymphoid organs. It includes bone marrow, blood vessels, lymph nodes, lymphatic vessels, thymus, spleen, and various other clusters of lymphoid tissue.
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a) Primary lymphoid organs.

The primary lymphoid organs produce and allow the maturation of lymphocytes. It also serves by generating lymphocytes from immature progenitor cells. Therefore it is referred to as the central lymphoid organs. Examples of primary lymphoid organs include thymus and the bone marrow.

b) Secondary lymphoid organs

The secondary lymphoid organs *are* referred to as the peripheral lymphoid organs as they are involved in promoting the sites for the interaction of lymphocytes with the antigen to become effector cells.

c) Tertiary lymphoid organs

The tertiary lymphoid organs usually contain very less number of lymphocytes. It plays an important role during the inflammation process.

Multiple choice questions:

- 1) The exaggerated response of the immune system to certain antigens present in the environment is called _____.
 - a) **Allergy**
 - b) Autoimmunity
 - c) Pathogens
 - d) Allergens
- 2) _____ is the ability of the body to fight against the diseases.
 - a) Parasites
 - b) Antibodies
 - c) Vaccination
 - d) **Immunity**
- 3) _____ is non-specific type of defence that is present at the time of birth.
 - a) Active immunity
 - b) Passive immunity
 - c) **Innate immunity**
 - d) Acquired immunity
- 4) Virus-infected cells secrete proteins called interferons which protect non-infected cells from further viral infection.
 - a) Physiological barriers
 - b) Cellular barriers
 - c) Physical barriers
 - d) **Cytokine barriers**
- 5) Skin on our body is the main barrier which prevents entry of the micro-organisms.

- a) Physiological barriers
 - b) Cellular barriers
 - c) Physical barriers**
 - d) Cytokine barriers
- 6) Acid in the stomach, saliva in the mouth, tears from eyes—all prevent microbial growth.
- a) Physiological barriers**
 - b) Cellular barriers
 - c) Physical barriers
 - d) Cytokine barriers
- 7) Certain types of leukocytes (WBC) of our body like polymorpho-nuclear leukocytes (PMNL-neutrophils) and monocytes and natural killer (type of lymphocytes) in the blood as well as macrophages in tissues can phagocytose and destroy microbes.
- a) Physiological barriers
 - b) Cellular barriers**
 - c) Physical barriers
 - d) Cytokine barriers
- 8) The B-lymphocytes produce an army of proteins in response to pathogens into our blood to fight with them. These proteins are called _____
- a) Antibodies.**
 - b) Cytokine barriers
 - c) Cell-mediated immunity
 - d) Heavy chains
- 9) When a host is exposed to antigens, which may be in the form of living or dead microbes or other proteins, antibodies are produced in the host body. This type of immunity is called
- a) Active immunity.**
 - b) Passive immunity
 - c) Innate immunity
 - d) Acquired immunity
- 10) When ready-made antibodies are directly given to protect the body against foreign agents, it is called
- a) passive immunity**
 - b) Active immunity
 - c) Innate immunity
 - d) Acquired immunity
- 11) These are important for healing wounds and defence against infections.
- a) Mast Cells**
 - b) Natural killer cells
 - c) Dendritic Cells
 - d) Basophils

12) These cells sense the infection and send the message to the rest of the immune system by antigen presentation.

- a) Basophils
- b) Mast Cells
- c) Natural killer cells
- d) **Dendritic Cells**

13) These circulate through the body and look for any foreign substance. They engulf and destroy it defending the body against that pathogen.

- a) **Phagocytes**
- b) Macrophages
- c) Basophils
- d) Dendritic Cells

14) These have the ability to move across the walls of the circulatory system. They release certain signals as cytokines to recruit other cells at the site of infections.

- a) Basophils
- b) Dendritic Cells
- c) **Macrophages**
- d) Phagocytes

15) These stop the spread of infections by destroying the infected host cells.

- a) Basophils
- b) Mast Cells
- c) **Natural killer cells**
- d) Dendritic Cells

16) These attack multicellular parasites. Like the mast cells, these release histamine.

- a) Phagocytes
- b) Macrophages
- c) **Basophils**
- d) Dendritic Cells

17) These contain granules that are toxic in nature and kill any pathogen that comes in contact.

- a) **Neutrophils**
- b) Macrophages
- c) Basophils
- d) Dendritic Cells

18) These contain highly toxic proteins that kill any bacteria or parasite in contact.

- a) Basophils
- b) Mast Cells
- c) **Eosinophil's**
- d) Dendritic Cells

19) In _____ body generates immune response against its own cells.

- a) Active immunity
- b) Innate immunity
- c) Autoimmunity**
- d) Passive immunity

20) _____ are involved in promoting the sites for the interaction of lymphocytes with the antigen to become effector cells.

- a) Primary lymphoid organs
- b) Secondary lymphoid organs**
- c) Territory lymphoid organs
- d) Cell-mediated immunity

21) These organs produce and allow the maturation of lymphocytes. It also serves by generating lymphocytes from immature progenitor cells.

- a) Primary lymphoid organs**
- b) Secondary lymphoid organs
- c) Territory lymphoid organs
- d) Cell-mediated immunity

22) These organs usually contain very less number of lymphocytes. It plays an important role during the inflammation process.

- a) Primary lymphoid organs
- b) Secondary lymphoid organs
- c) Territory lymphoid organs**
- d) Cell-mediated immunity

23) _____ is a simple, safe, and effective way of protecting you against harmful diseases.

- a) Blood test
- b) Vaccination**
- c) Antibiotics
- d) Diagnosis

24) Physiological barriers provide immunity to the body.

- a) Acid in stomach**
- b) Dilute hydrochloric acid in the stomach
- c) Mucus coating of the epithelium lining the respiratory tract

d) Both A and C

25) Which of the following is a physical barrier that provides innate immunity against invading pathogens?

a) Acid in stomach

b) Dilute hydrochloric acid in the stomach

c) Mucus coating of the epithelium lining the respiratory tract

d) Both A and C