UNIT 14 : IMMUNE SYSTEM

Unit Structure

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14.1 Learning Outcomes

After studying this unit, you would able to

Understand about the Immune system of human body

Know about the function of Immune system

Identify the components organ of Immune system of our body

14.2 -Introduction



The immune system is the body's defence system that protects against harmful invaders such as bacteria, viruses, fungi, and other pathogens. It consists of a complex network of cells, tissues, and organs that work together to recognize, attack, and destroy foreign substances that could cause illness or infection.

The immune system has two main types of responses:

Innate immunity: The body's general defence against invaders, which responds immediately to any pathogen.

Adaptive immunity: A more specialized response where the body "remembers" and specifically targets previously encountered pathogens for faster responses in the future (this is the basis for vaccines).

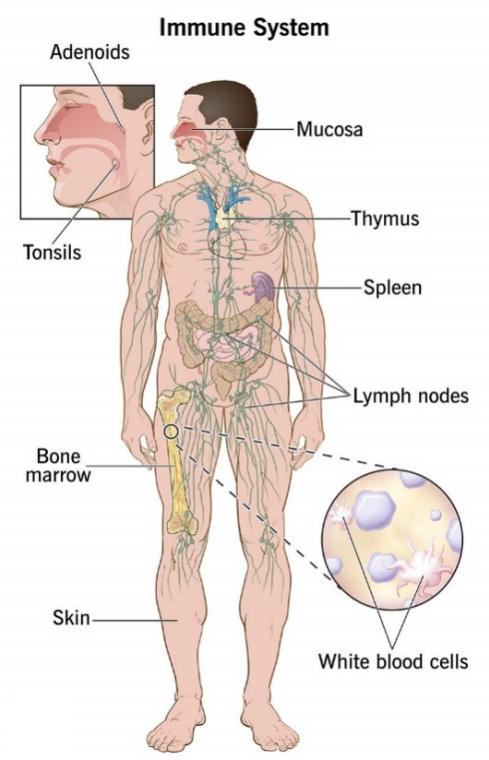
In short, the immune system keeps the body healthy by detecting, fighting, and eliminating potentially harmful threats.

14.3– Component organs of Immune system

The immune system is composed of various organs, tissues, and cells that work together to protect the body from harmful invaders. The major **component organs** of the immune system include:

1. Bone Marrow

Function: The bone marrow is the primary site where all blood cells, including immune cells like white blood cells (leukocytes), are produced. It is responsible for generating B-cells and immature T-cells.



2. Thymus

Function: The thymus is a small gland located behind the breastbone, where T-cells (a type of lymphocyte) mature. T-cells are crucial for adaptive immunity, which targets specific pathogens.

3. Spleen

Function: The spleen filters blood, removes old or damaged red blood cells, and helps detect and respond to pathogens in the bloodstream. It contains immune cells like B-cells, T-cells, and macrophages that are involved in producing antibodies and fighting infections.

4. Lymph Nodes

Function: Lymph nodes are small, bean-shaped structures located throughout the body. They act as filters, trapping pathogens, and other foreign substances from lymph fluid. They are also sites where immune cells, such as lymphocytes, can communicate and mount an immune response.

5. Lymphatic Vessels

Function: These vessels transport lymph fluid (a clear fluid containing white blood cells) throughout the body. Lymphatic vessels help circulate immune cells and drain excess fluid from tissues back into the bloodstream.

6. Mucosa-associated Lymphoid Tissue (MALT)

Function: This is a collection of lymphoid tissues found in mucous membranes throughout the body, including the digestive tract, respiratory tract, and urogenital tract. Examples of MALT include:

Tonsils and Adenoids (in the throat)
Peyer's Patches (in the small intestine)
Appendix (in the large intestine) These structures protect the body from pathogens that enter through mucosal surfaces.

7. Skin

Function: The skin is the body's largest organ and serves as a physical barrier to pathogens. It also contains immune cells like macrophages and dendritic cells that can recognize and attack invaders.

8. Liver

Function: The liver plays a supportive role in immunity by producing proteins involved in the immune response, such as complement proteins that assist in pathogen elimination. It also clears dead immune cells and pathogens from the blood.

9. Tonsils and Adenoids

Function: Located at the back of the throat, tonsils and adenoids trap pathogens that enter through the mouth and nose, helping to activate immune responses.

10. Gut-associated Lymphoid Tissue (GALT)

Function: This part of the immune system is found in the digestive tract, particularly the intestines. It includes structures like Peyer's patches and lymphoid follicles that help prevent infections from pathogens ingested with food.

11. Appendix

Function: Once considered a vestigial organ, the appendix now is thought to play a role in housing good bacteria and contributing to gut immunity.

These organs and tissues are critical in ensuring that the immune system functions properly to protect the body from infections and other harmful substances. Together, they form a coordinated defence system that identifies, attacks, and remembers pathogens.

14.4– Functions of Immune system

The immune system has several vital functions aimed at defending the body against harmful pathogens, such as viruses, bacteria, fungi, parasites, and toxins. Its main purpose is to maintain the body's health by preventing infections and eliminating foreign substances. The key **functions of the immune system** include:

1. Defence Against Pathogens

Function: The immune system identifies and neutralizes foreign invaders like bacteria, viruses, fungi, and parasites that can cause infections

and diseases. It acts as a protective barrier and response mechanism to these pathogens.

Example: When a virus enters the body, the immune system detects and attacks it with specialized immune cells and proteins.

2. Recognition of Foreign Substances (Antigens)

Function: The immune system has the ability to recognize molecules on the surface of pathogens, called antigens, as foreign or "non-self." This recognition triggers an immune response.

Example: When bacteria enter the body, their specific antigens are identified by immune cells like B-cells and T-cells, which then initiate an attack.

3. Production of Antibodies

Function: B-cells, a type of lymphocyte, produce antibodies—proteins that bind to specific antigens on pathogens to neutralize or destroy them. Antibodies also mark pathogens for destruction by other immune cells.

Example: During a viral infection, B-cells produce antibodies that target the virus, preventing it from infecting more cells and aiding in its removal from the body.

4. Elimination of Abnormal or Damaged Cells

Function: The immune system monitors the body for abnormal cells, such as cancer cells or damaged cells, and eliminates them before they can cause harm. This process is carried out by immune cells like natural killer (NK) cells and cytotoxic T-cells.

Example: If a cell becomes cancerous, NK cells or T-cells can detect the abnormal cell and destroy it, preventing the spread of cancer.

5. Inflammatory Response

Function: Inflammation is the immune system's response to injury or infection. It helps isolate the affected area, bringing immune cells and other factors to the site to eliminate pathogens and start the healing process.

Example: When you get a cut, the area becomes red, swollen, and painful as immune cells rush to fight off any bacteria that may enter through the wound.

6. Immunological Memory

Function: After an immune response, the immune system creates memory cells (memory B-cells and memory T-cells) that "remember" the pathogen. This allows the body to respond more quickly and effectively if it encounters the same pathogen again in the future.

Example: Vaccinations work by exposing the immune system to a weakened or inactive form of a pathogen, allowing it to develop memory cells that will recognize and respond to the pathogen if exposed again.

7. Immune Surveillance

Function: The immune system continuously monitors the body for pathogens, abnormal cells, or foreign substances, responding rapidly to potential threats. This involves circulating immune cells throughout the body and within various tissues.

Example: Immune cells patrol the blood and tissues, ready to respond to any signs of infection or tissue damage.

8. Tissue Repair and Wound Healing

Function: After an infection or injury, the immune system plays a crucial role in repairing tissue and promoting wound healing. Inflammatory cells clear out dead cells and pathogens while promoting tissue regeneration.

Example: When you scrape your skin, immune cells not only fight off any infections but also help clean up the damaged tissue and initiate healing.

9. Distinguishing Self from Non-Self

Function: The immune system is able to distinguish the body's own healthy cells (self) from foreign invaders (non-self). This prevents the immune system from attacking its own tissues.

Example: Autoimmune diseases occur when the immune system mistakenly attacks the body's own cells, failing to distinguish them from harmful invaders.

10. Regulation of Immune Responses

Function: The immune system regulates its responses to ensure that they are appropriate in magnitude and duration. This prevents excessive damage to the body's own tissues, which can happen if the immune response is too strong or prolonged.

Example: Regulatory T-cells suppress overactive immune responses to prevent tissue damage during inflammation.

In summary, the immune system is essential for protecting the body against infections, clearing damaged cells, and ensuring that the body can heal from injuries, while also maintaining a balance to prevent excessive immune reactions.

14.5 LET US SUM UP

Immune System Functions:

Defence Against Pathogens: Protects the body from viruses, bacteria, fungi, and other harmful invaders.

Recognition of Foreign Substances: Detects and responds to antigens (foreign molecules) on pathogens.

Production of Antibodies: B-cells create antibodies to neutralize or destroy pathogens.

Elimination of Abnormal Cells: Targets and removes abnormal or damaged cells, such as cancer cells.

Inflammatory Response: Triggers inflammation to fight infections and initiate healing.

Immunological Memory: Remembers past pathogens, enabling faster responses in future infections.

Immune Surveillance: Constantly monitors for potential threats in the body.

Tissue Repair and Wound Healing: Plays a role in repairing tissue after injury.

Distinguishing Self from Non-Self: Prevents the immune system from attacking its own tissues.

Regulation of Immune Responses: Ensures immune reactions are appropriate and do not harm the body.

Key Immune System Components:

Bone Marrow: Produces blood cells, including immune cells.

Thymus: Matures T-cells, important for adaptive immunity.

Spleen: Filters blood and fights pathogens.

Lymph Nodes and Vessels: Filter lymph fluid and circulate immune cells.

Mucosa-associated Lymphoid Tissue (MALT): Defends mucosal surfaces, such as in the digestive and respiratory tracts.

Skin: Serves as a physical barrier and contains immune cells.

Liver: Produces immune proteins and clears pathogens from the blood.

Tonsils and Adenoids: Trap pathogens entering through the mouth and nose.

Gut-associated Lymphoid Tissue (GALT): Protects against pathogens in the digestive tract.

Together, these functions and components create a sophisticated defence system that keeps the body healthy by recognizing, attacking, and remembering harmful pathogens.

CHECK YOUR PROGRESS

What are the types of Immune system?

What type of lymphocyte is responsible for producing antibodies in the immune system?

Which components of the immune system are primarily involved in creating memory cells?

What are the major component organs of immune system?

What is the function of Spleen?

14.6 FUTURE READING

Physiology of sports and exercise by W. Larry Kenney, Jack H. Wilmore, and David L. costill.

Gupta, A. P. (2010). Anatomy and physiology. Agra: Sumit Prakashan.

Gupta, M. and Gupta, M. C. (1980). Body and anatomical science. Delhi: Swaran Printing Press.

Guyton, A.C. (1996). Textbook of Medical Physiology, 9th edition. Philadelphia: W.B. Saunders.

Blaisdall, A. (2001). Human Anatomy and Physiology. Delhi: Lokesh Thani Sports Publications.

14.7 ANSWERS TO CHECK YOUR PROGRESS

Answer: - Innate immunity and Adaptive immunity.

Answer: - B-cells, a type of lymphocyte, produce antibodies.

Answer: - B-lymphocytes and T-lymphocytes, also known as white blood cells, are the primary components of the immune system that create memory cells.

Answer : - The major organs of the immune system are the bone marrow, thymus, lymph nodes, spleen, and tonsils.

Answer: - The spleen filters blood, removes old or damaged red blood cells, and helps detect and respond to pathogens in the bloodstream.

14.8 MODEL QUESTIONS

Q.1 What is the primary difference between innate immunity and adaptive immunity?

Q.2 How does the immune system recognize and respond to foreign invaders in the body?

Q.3 Describe the role of B-cells and T-cells in the immune response.

Q.4 What is the significance of immunological memory, and how does it relate to vaccinations?

Q.5 Explain the process and importance of antibody production in fighting infections.

Q.6 How does the immune system eliminate abnormal or damaged cells, such as cancer cells?

Q.7 What is the inflammatory response, and how does it help in healing after an injury?

Q.8 List and explain the main organs involved in the immune system and their specific functions.

Q.9 How does the immune system distinguish between "self" and "non-self" cells?

Q.10 What role do lymph nodes and the lymphatic system play in the body's immune defence?

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