Lecture one Introduction Dr. wurood Ali

Immune system

The Immune System - includes all parts of the body that help in the recognition and destruction of foreign materials. White blood cells, phagocytes and lymphocytes, bone marrow, lymph nodes, tonsils, thymus, and your spleen are all part of the immune system.

Immunity :- refers to protection against infection.

The immune system:-is the collection of cells, tissues and molecules that functions to defend us against infectious microbes. The coordinated reaction of the immune system against infections (and other foreign substances) is known as the immune response.

Cells and Organs of the Immune System

Immune responses are mediated by a variety of cells and by the soluble molecules that they secrete. Leukocytes (WBCs) are central to all immune responses. Other cells in the tissues, such as macrophages and cytokines liberated by lymphocytes, also contribute to the immune response. A number of morphologically and functionally diverse organs and tissues function in the development of immune responses. These can be divided as Primary Lymphoid Organs and Secondary Lymphoid Organs.

Primary Lymphoid Organs:- include (Thymus and Bone marrow)

Secondary Lymphoid Organs :- include (Tonsil, Lymph node, Spleen, Peyer's patches, Appendix and Tissue lymphatic) .

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The immune system is typically divided into two categories innate and adaptive:-

Innate immunity (non specific immunity)

1- Innate Immune System

First-Line Defenses - The body's first line of defense against pathogens uses mostly physical and chemical barriers such as

A- Skin – acts as a barrier to invasion

B-Sweat – has chemicals which can kill different pathogens.

C-Tears - have lysozyme which has powerful digestive abilities that render antigens harmless.

D-Saliva – also has lysozyme.

E-Mucus - can trap pathogens, which are then sneezed, coughed, washed away, or destroyed by chemicals.

F-Stomach Acid – destroys pathogens

Second-Line Defenses - If a pathogen is able to get past the body's first line of defense, and an infection starts, the body can rely on its second line of defense. This will result in what is called an Inflammatory response causes

A- Redness - due to capillary dilation resulting in increased blood flow

B- Heat - due to capillary dilation resulting in increased blood flow

C- Swelling – due to passage of plasma from the blood stream into the damaged tissue

D- Pain – due mainly to tissue destruction and, to a lesser extent, swelling.

Adaptive immunity refers to antigen-specific immune response.

The adaptive immune response is more complex than the innate.

A- Third-Line Defenses - Sometimes the second line of defense is still not enough and the pathogen is then heading for the body's last line of defense, the immune system.

B- The immune system recognizes, attacks, destroys, and remembers each pathogen that enters the body. It does this by making specialized cells and antibodies that render the pathogens harmless.

C- Unlike the first line and second line defense the immune system differentiates among pathogens.

D- For each type of pathogen, the immune system produces cells that are specific for that particular pathogen.

Difference between Innate and Adaptive Immunity

No.	Characteristics	Innate Immunity	Adaptive immunity
1.	Presence	Innate immunity is something already present in the body.	Adaptive immunity is created in response to exposure to a foreign substance.
2.	Specificity	Non-Specific	Specific
3.	Response	Fights any foreign invader	Fight only specific infection
4.	Response	Rapid	Slow (1-2 weeks)
5.	Potency	Limited and Lower potency	High potency
6.	Time span	Once activated against a specific type of antigen, the immunity remains throughout the life.	The span of developed immunity can be lifelong or short.
7.	Inheritance	Innate type of immunity is generally inherited from parents and passed to offspring.	Adaptive immunity is not passed from the parents to offspring, hence it cannot be inherited.
8.	Memory	Cannot react with equal potency upon repeated exposure to the same pathogen.	Adaptive system can remember the specific pathogens which have encountered before.
9.	Presence	Present at birth	Develops during a person's lifetime and can be short-lived.
10.	Allergic Reaction	None	Immediate and Delay hypersensitivity
11.	Used Against	For microbes	Microbes and non-microbial substances called antigens
12.	Memory	No memory	Long term memory
13.	Diversity	Limited	High

No.	Characteristics	Innate Immunity	Adaptive immunity
14.	Speed	Faster response	Slower response
15.	Complement system activation	Alternative and lectin pathways	Classical pathway
16.	Anatomic and physiological barriers	Skin, Mucous membranes, Temp, pH, chemicals, etc.	Lymph nodes, spleen, mucosal associated lymphoid tissue.
17.	Composition	The innate immune system is composed of physical and chemical barriers, phagocytic leukocytes, dendritic cells, natural killer cells, and plasma proteins.	Adaptive immune system is composed of B cells and T cells.
18.	Development	Evolutionary, older and is found in both vertebrates and invertebrates.	Adaptive immunity system has been developed recently and is found only in the vertebrates.
19.	Example	White blood cells fighting bacteria, causing redness and swelling, when you have a cut.	Chickenpox vaccination so that we don’t get chickenpox because adaptive immunity system has remembered the foreign body.

Active immunity

is a host immune response induced after contact with foreign antigens (e.g., microorganisms). This contact may occur through an infection or an immunization with microbial toxins or antigens. In all these instances, the host actively responds by making antibodies and activated T lymphocytes (i.e., adaptive immunity).

The main advantage of active immunity is that : resistance is long term.

Its major disadvantage is its slow onset, especially the primary response.

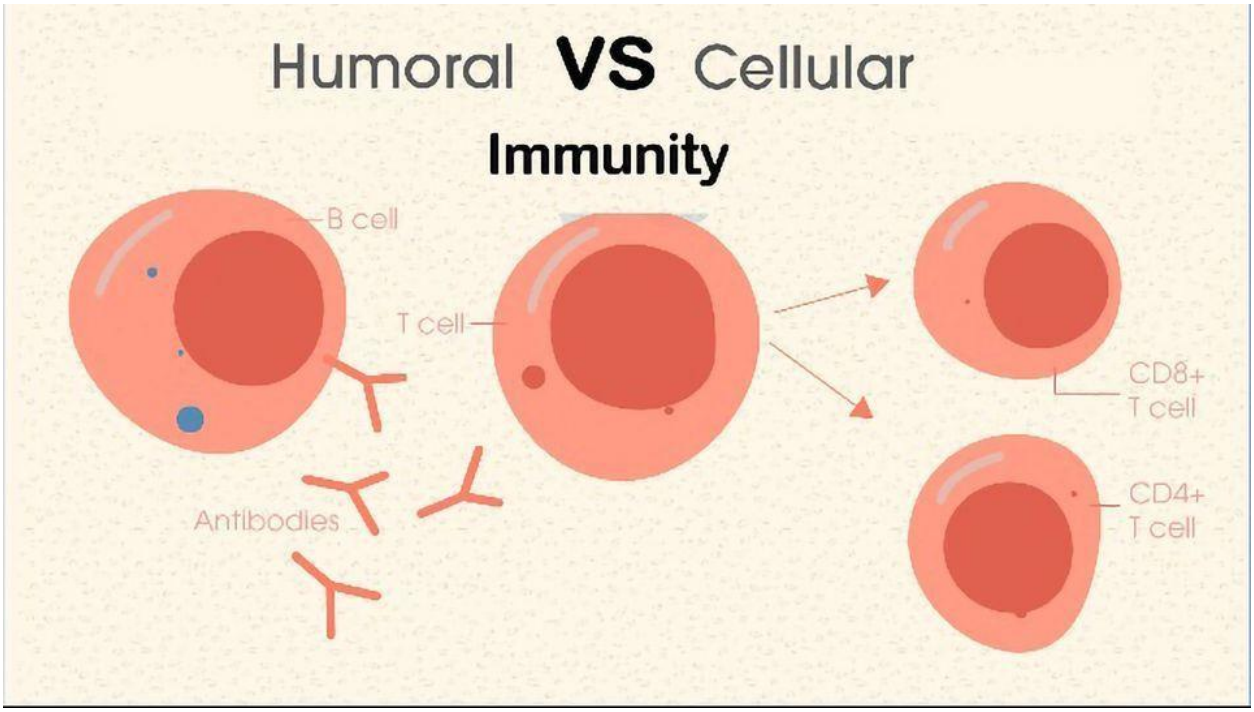
Passive immunity

is given to a person in the form of immune components that were performed in another person or animal.

(Humoral and cellular immunity)

Humoral immunity is an antibody-mediated response that occurs when foreign material - antigens - are detected in the body. This foreign material typically includes extracellular invaders such as bacteria. This mechanism is primarily driven by B cell lymphocytes , a type of immune cell that produces antibodies after the detection of a specific antigen.

Cellular immunity :- Unlike humoral immunity **, cell-mediated immunity** does not depend on antibodies for its adaptive immune functions. Cell-mediated immunity is primarily driven by mature T cells, macrophages, and the release of cytokines in response to an antigen.



IMMUNOGENS

An immunogen is any molecule that induces an immune response. antigens are immunogens that react with the highly specific receptors on T cells or B cells.

1. Antigens :- The features that determine immunogenicity are as follows:

A-Foreignness In general, only molecules recognized as "nonself" or foreign are immunogenic (i.e., we are tolerant to our own molecules) .

B-Molecular Size The most potent immunogens are large proteins (i.e., molecular weights above 100,000 g/mol), whereas midsized molecules (i.e., molecular weight below 10,000 g/mol) are weakly immunogenic, and very small ones (e.g., amino acids) are nonimmunogenic.

C-Chemical–Structural Complexity Some chemical complexity is required for immunogenicity. For example, peptide "homopolymers" that contain a single type

of amino acid are less immunogenic than peptides containing diverse amino acids.

D-Antigenic Determinants (Epitopes) :-

Epitopes :- are the chemical features on an antigen that physically bind to antibody or Tcell receptors. Most antigens have more than one epitope (i.e., they are multivalent).

E-Dosage, Route, and **Timing of Antigen Exposure** :- Vaccine research aims to optimize these factors to find regimens with the best balance of highest immunogenicity, fewest side effects, and most convenient administration.

F- Host Genetics: - The genetic makeup of each individual (especially the genes that form the MHC, can determine that individual's response to a particular immunogen.

2- Haptens :- In contrast to an antigen, a hapten is a molecule that is not immunogenic by itself but can react with specific antibody. Haptens can be small molecules, nucleic acids, lipids, or drugs (e.g., penicillins), but because they are not peptides, they cannot activate helper T cells.

3- Adjuvants Adjuvants

Enhance the immune response to an immunogen, but they do so without binding to antibody or to the immunogen.