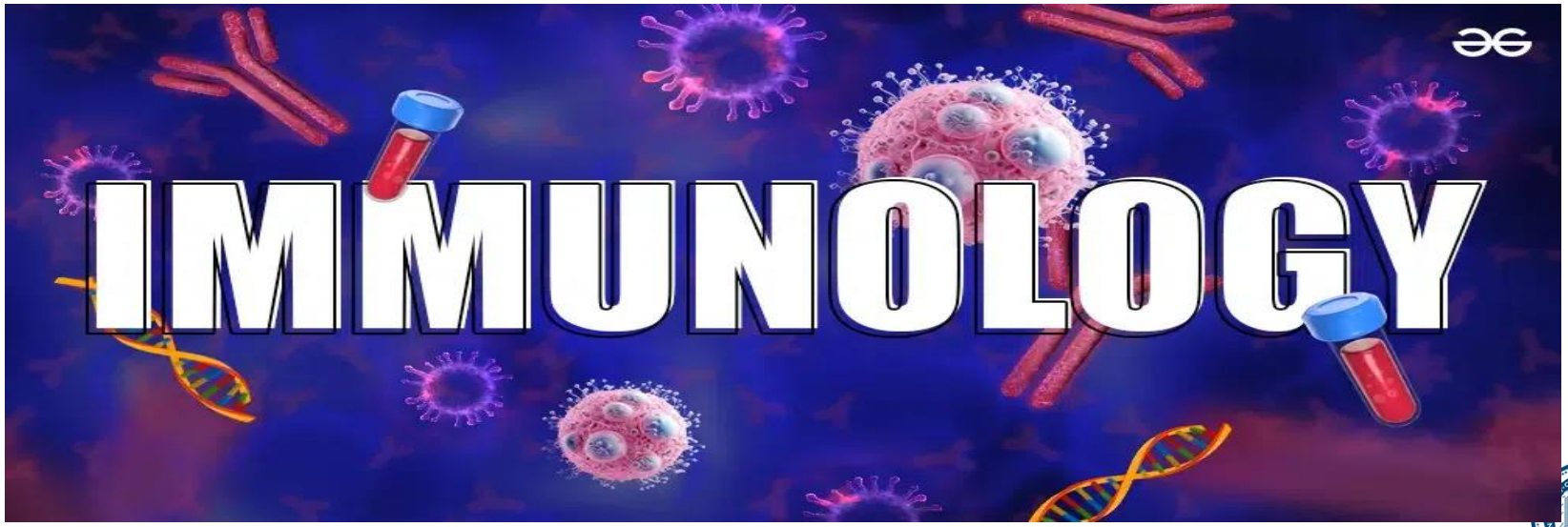
Immunology

Asst . Prof .Dr. Bara' Hamid



Immunology

• **Immunology** is a branch of biomedical science that covers the study of immune systems in all organisms. It deal with the response of an organism to antigenic challenge.

• Immunity (resistance)

• It is the sum of all naturally occurring defense mechanisms that protect humans from infectious disease.

- **Immune system**

The immune system refers to a collection of organs, cells and proteins that function to protect all the body (skin, respiratory and intestinal tract and other areas) from foreign antigens, such as microbes (bacteria, fungi, viruses and parasites).

Two important types :

I. Innate (natural) or non-specific immunity

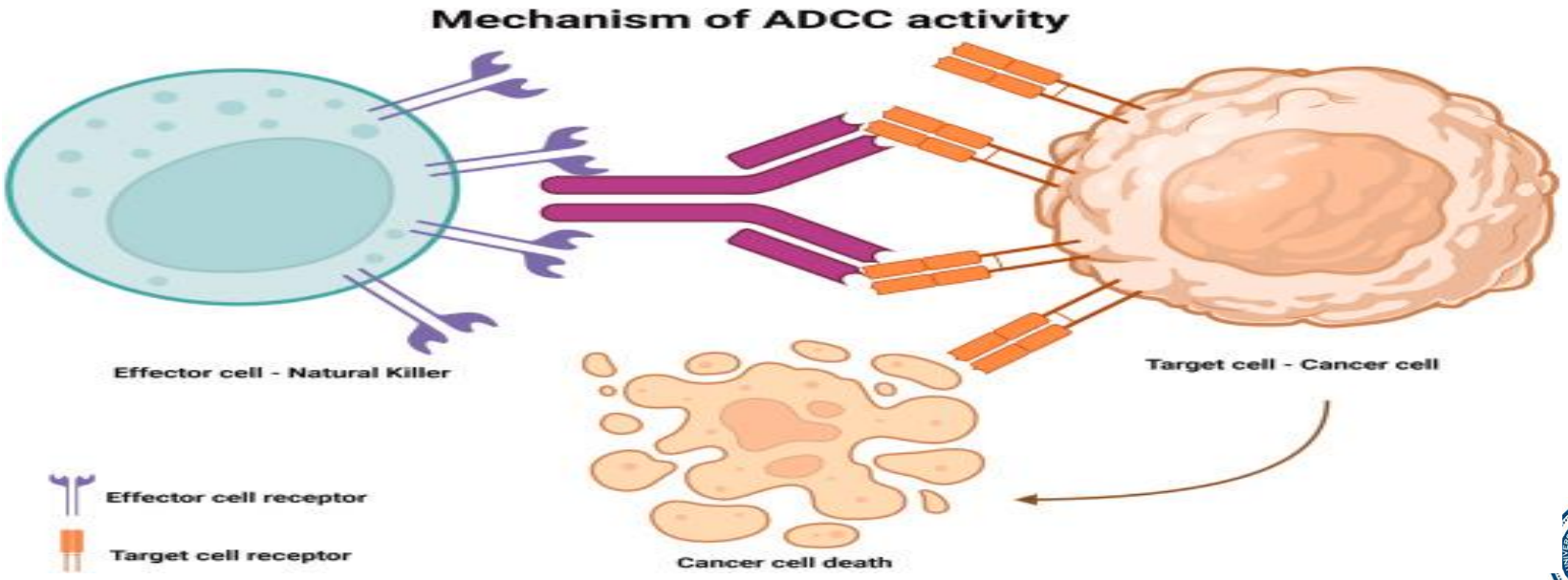
II. Adaptive (acquired) or specific immunity

- **Defensive mechanisms include :**

1) Innate immunity (Natural or Non specific)

2) Acquired immunity (Adaptive or Specific)

- Cell-mediated immunity.
- Humoral immunity.



Component of Innate Immunity :

- Innate Immune system

First line ,include :

1) Mechanical barriers .

2) Chemical & biochemical inhibitors.

3) Normal flora

Second line ,include:

A- cells

1- Natural killer

2- Phagocytes

B- Soluble factors

C- Inflammatory barriers

First line

1) Mechanical barriers :

- Intact skin
- Mucous coat
- Mucous secretion
- Blinking reflex and tears
- The hair at the nares
- Coughing and sneezing reflex

First line

2) Chemical & biochemical inhibitors:

- Sweet and sebaceous secretion
- Hydrolytic enzymes in saliva
- HCl of the stomach
- Proteolytic enzyme in small intestine
- Lysozyme in tears
- Acidic pH in the adult vagina

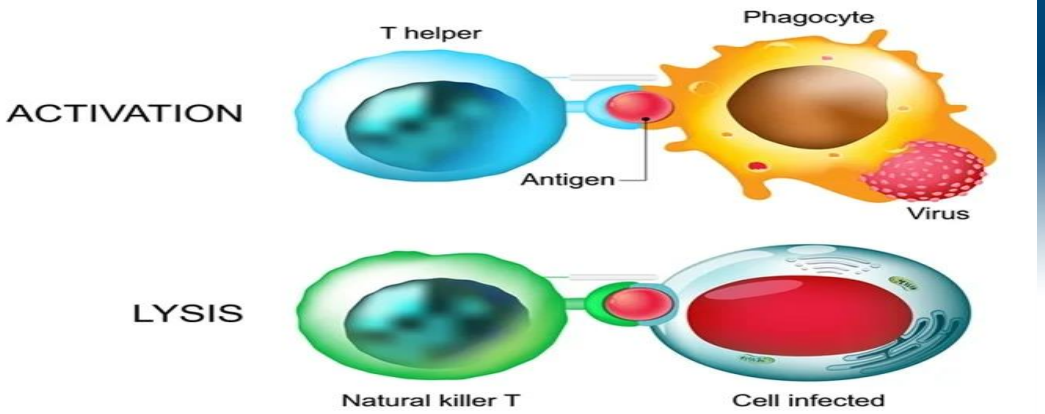
First line

3) Normal bacterial flora :

- Competition for essential nutrients
- Production of inhibitory substances

Second line

A) cells:



1- Natural killer (NK) :

Definition: Large granular lymphocytes , Innate cytotoxic lymphocytes .

Source : Bon marrow precursors

Location : 10% or 15% of lymphocytes in peripheral blood

1% or 2% of lymphocytes in spleen

Function : Cytotoxic for :

Tumor cells , Viral infected cells , Bacterial, fungal, parasitic infection

Responsible for : antibody–dependent cell

mediated cytotoxicity **(ADCC)**

Second line

2- Phagocytes :

Specialized cells for capture, Ingestion and destruction of invading microorganisms.

* Polymorphonuclear leucocytes, mainly neutrophils: granulocytes circulate in blood

* Mononuclear cells (macrophages)

- Monocytes in blood

- Histocytes in connective tissues

- Fixed reticuloendothelial cells in liver spleen, lymph nods, bon marrow.

Second line

B- Soluble factors :

1- Acute phase protein (Plasma protein, CRP=C reactive protein, Fibrin.)

2- Complement (proteins in serum, body fluids)

2- Interferons (Proteins against viral infections)

3- Properdin (Complement activation)

4- Beta lysine (Antibacterial protein from Platelets)

5- Lactoferrrin,Transferrin (Iron binding protein)

6- Lactoperoxidase (Saliva & Milk)

7- Lysozyme (Hydrolyze cell wall)

Interferons :

Proteins usually produced by virally infected cells

*** Types of interferons:**

1- Alpha interferon :Secreted by Macrophages

Induced by Viruses or Polynucleotide

2- Beta interferon :Secreted by Fibroblasts, Viruses

3- Gamma interferon :T- lymphocytes, Specific antigens

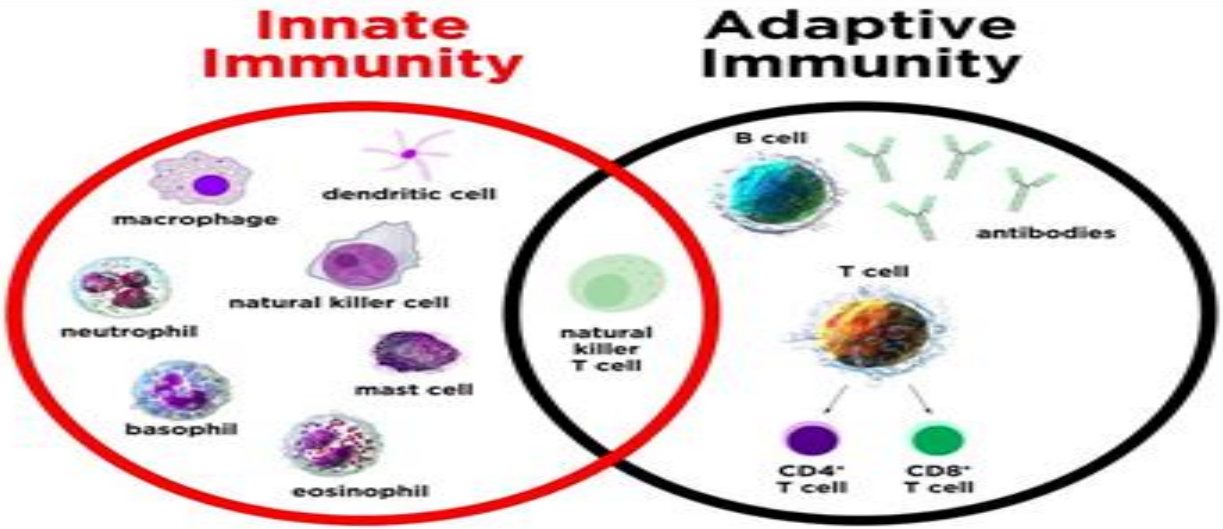
Interferons :

Protective action of interferons:

1) Activate T-cells

2) Activate macrophages

3) Activate NK



Phagocytosis:

The engulfment, digestion, and subsequent processing of microorganisms by macrophages and neutrophils

1) Chemotaxis & attachment:

a- Attraction by chemotactic substances (microbes, damaged tissues)

b- Attachment by receptors on surfaces of phagocytes

Phagocytosis:

2) Ingestion:

* Phagocyte pseudopodia surround organism forming phagosom

* Opsinins and co-factors enhance phagocytosis

* Fusion with phagocyte granules and release digestive, toxic contents

Phagocytosis:

3- Killing (two microbicidal routes)

a- Oxygen depended system (powerful microbicidal agents)

Oxygen converted to superoxide, anion,

hydrogen peroxide, activated oxygen and

hydroxyl radicals.

b- Oxygen-independent system (anaerobic

conditions)

Digestion and killing by lysozyme. Lactoferrin, low pH, cationic proteins and hydrolytic and proteolytic enzymes

C) Inflammatory Barriers:

* Tissue damage by a wound or by invading pathogen

* Inflammatory response:

Release of chemical mediators from : Tissue damage ,

Leukocytes , Invading microbe .

(Histamine, fibrin, kinins, cytokines)

Vasodilatation of capillaries: Redness of tissue , increase tissue temperature , increase capillary permeability ,Influx of fluids , Influx of phagocytes into tissues

Adaptive Immunity

Once the barriers of the innate immune response have been breached, the adaptive immune response is activated in an antigen specific fashion to provide for elimination of antigen and lasting protection from future challenge.

Types of adaptive immune response :

Humoral immunity:

Is mediated by molecules in the blood and mucosal secretions called antibodies which are produced by B lymphocytes.

Humoral immunity is the principal defense mechanism against extracellular microbes and their toxins because secreted antibodies can bind to these microbes and toxins and assist in their elimination.

Types of adaptive immune response

Cell- mediated immunity: also called cellular immunity, is mediated by T lymphocytes

cellular immunity is primarily directed against intracellular microbes such as viruses and some bacteria that survive and proliferate inside host cells where they are inaccessible to circulating antibodies.

The cellular components of the adaptive immune system are:

1- Lymphocytes (T cells and B cells) and plasma cells (end cells of B- lymphocyte differentiation).

2- Antigen-presenting cells (APCs)(Macrophages, B cells, and dendritic cells).

Adaptive immune defenses have in common that they are:

- **Specific** for particular antigens and are specialized to provide the best protection.
- **Diverse** in their specificity.
- Enhance with each repeated exposure (express **Immunologic memory**).
- Capable of **self/non-self** recognition.
- **Self-limiting.**

These features of adaptive immunity are designed to give the individual the best possible defense against disease.

- ✓ **Specificity** is required, along with memory to protect against persistent or recurrent challenge.
- ✓ **Diversity** is required to protect against the maximum number of potential pathogens.
- ✓ **Specialization** of function is necessary so that the most effective defense can be mounted against diverse challenges.

- ✓ **The ability to distinguish between** invaders and one's own cells and tissues **(self versus non-self)** is vital in inhibiting a response to one's own cells (autoimmunity).
- ✓ **Self-limitation** allows the system to return to a basal resting state after a challenge to conserve energy and prepare for the challenge by new microbes.

Types of Specific Immunity

Naturally acquired active immunity :

– type of specific immunity a host develops after exposure to foreign substance .

Naturally acquired passive immunity :

– transfer of antibodies, e.g., mother to fetus across placenta, mother to infant in breast milk .

Artificially acquired active immunity (vaccination):

– intentional exposure to a foreign material .

Artificially acquired passive immunity:

– preformed antibodies or lymphocytes produced by one host are introduced into another host

Thanks