Mechanisms of Specific Host Defense

Lect. 3 **Dr. Basim Mohammed Hanon**

Mechanisms of acquired immunity:

1. Humoral immunity: - is mediated by **B cells**; in response to extracellular antigens, these may be triggered to proliferate and then differentiate **into plasma cells** that function as **antibody producing factories.**

2. Cellular Immunity: - Effector **T- cytotoxic cells** are able to induce apoptosis in 'self" cells that present abnormal protein that signify danger. Effector T-helper orchestrates the various **response of cellular and humoral immunity**.

Passive Immunity:-

- ❒ Passive immunity is transmitted by **antibodies or lymphocytes** preformed in another host.
- ❒ The passive administration of antibody (in antisera) against certain viruses (eg, hepatitis B) **can be useful during the incubation period to limit viral multiplication**, eg, after a needle-stick injury to someone who has not been vaccinated.

The main advantage: - of passive immunization with preformed antibodies is the prompt availability of **large amounts of antibody**;

Disadvantages: - **the short life span** of these antibodies and **possible hypersensitivity reactions** if antibodies (immunoglobulins) from another species are administered.

Active Immunity:-

- ❒ Active immunity is induced after **contact with foreign antigens** (eg, microorganisms or their products).
- ❒ This contact may consist of **clinical or subclinical infection**, **immunization** with live or killed infectious agents or their antigens, exposure to **microbial products** (eg, toxins, toxoids), or **transplantation of foreign cells**.
- ❒ In all these instances the **host actively produces antibodies**, and **lymphocytes** acquire the ability to respond to the antigens.

Advantages: - of active immunity include **long-term protection** (based on **memory** of prior contact with antigen and the **capacity to respond faster** and to a greater extent on subsequent contact with the same antigen.

Disadvantages: - include the **slow onset of protection** and the need for prolonged or repeated contact with the antigen.

Adaptive/acquired Immunity can be active or passive natural or artificial.

Note

Active immunity: produce our own Ab.

Passive immunity Ab acquired from another source.

Acquired (Adaptive) Immunity:-

Adaptive immunity, which occurs after exposure to an antigen (eg, an infectious agent) is specific and is mediated by either antibody or lymphocytes. It can be passive or active.

Modes of Specific Immunity

1. **Naturally acquired**

a. Passive: Placental Ab transfer.

b. Active: Recovery from disease.

2. **Artificially acquired**

a. Passive: Antitoxin administration, e.g., rabies or tetanus

b. Active: Vaccination,

Adaptive immunity	**Active**	**Passive**
Natural	Exposure to antigen induces an immune response like, immunity that follows attacks of measles or canine distemper.	Transfer of antibodies or cells produced by others as temporary immunity from antibodies of the mother transferred to infant across the placenta or in milk.
Artificial	Deliberate exposure to antigen induces an immune response e.g. immunization of children or young animals	Antibodies in immune serum are introduced into body e.g. injection of rabies immune globulin after dog bite

Induction of the Acquired (or Adaptive) Immune Response

1. **First exposure to a foreign substance (antigen)**. This foreign substance induces **lymphocytes to:**

- ❒ **Proliferate,** ❒ **Differentiate,** ❒ **Produce soluble substances,**
- ❒ **Antibodies,** ❒ **Cytokines,** ❒ **Establish memory.**

2. Three major types of cells participate in this adaptive system:

- ❒ **Macrophages**,
- ❒ **T cells and B cells.**
  - ❖ Macrophages are nonspecific and are involved in **processing Ag and presentation in peptides material to T cells**.
  - ❖ **T cells collaborate with B cells to stimulate the production of antibody**.
  - ❖ **B cells synthesize and secrete antibodies** with the ability to react with specific antigen.

3. A/ Differentiation of B lymphocytes:

- ❒ B lymphocytes differentiate into **plasma cells that secrete large amounts of antibody** (immunoglobulin).
- ❒ B cells use **surface antibody to bind to antigen**. This causes them to **become activated and secrete more immunoglobulin.**

4. B/ Differentiation of T lymphocytes:

- ❒ Cellular differentiation (CD) proteins are **specific markers for particular cells**.
- ❒ Two major types of T cells exist: **CD4 (helper)** and **CD8 (cytotoxic)** T lymphocytes. These are classified on the basis of expression of cell-surface CD proteins.

i. **CD4+ T lymphocytes**: Helper T cells are CD4 positive. They enhance both **humoral and cell-mediated immunity.**

ii. **CD8+ T lymphocytes: Cytotoxic T cells are CD8 positive**. They are a part of the cell mediated immune response **against virus-infected cells or tumor cells**.

5. **The T-cell receptor (TCR):** A specific surface molecule of the T cell that recognizes and reacts with foreign antigen presented to the T cells by a variety of **antigen-presenting cells**, including: **A. Macrophages B. Dendritic cells C. B cells**

- Remember: **Mature T cells do not have BOTH CD4 and CD8 molecules on the same cell.**

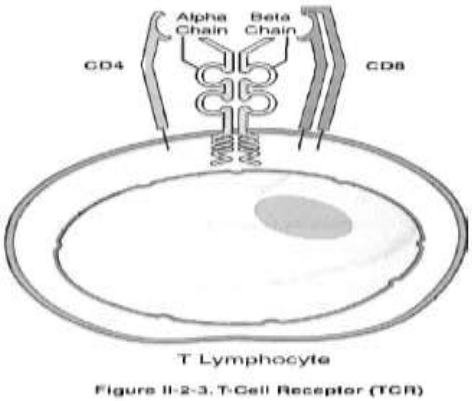
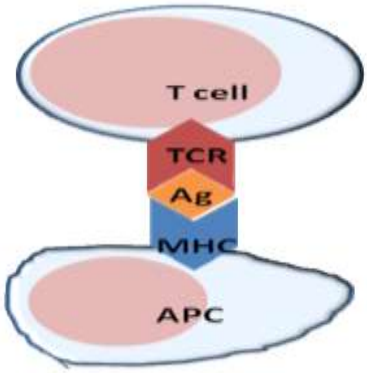


Figure II-2-3. T-Cell Receptor (TCR)



T Lymphocytes: Antigen Recognition and Response:-

Functions of Effector T-Cytotoxic (CD8) Cells:-

1:- T-cytotoxic cells induce apoptosis in cell that produce proteins associated with danger, they also **produce cytokines t**hat allow neighboring cells to against **intracellular invaders.**

2:- All nucleated cells **present peptides** from endogenous protein in the **groove of MHC class molecules.**

Functions of Effector T-helper (CD4) Cells:-

- ❒ T-helper cells respond to **exogenous antigen**, which are presented to **MHC class II molecules.**
- ❒ Th1 cells judge **antigens presented by macrophages**, a responding Th1 cell activates that **particular macrophage** and **secrete cytokines** that help orchestrate the immune response.
- ❒ Th2 cells judge antigen **presented by B. cells**; a responding **Th2 cell activates** that particular B. cell and supports actions that enhance its effectiveness.

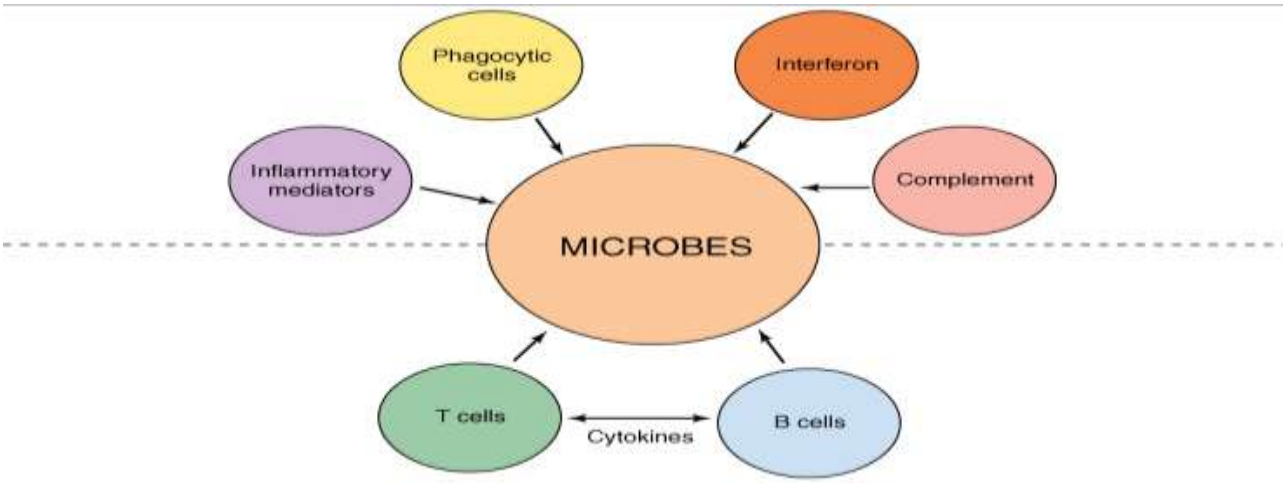
Lymphocytes and the Antibody Response:-

The Response to T-Independent Antigens:-

1. T-independent antigens include polysaccharides.

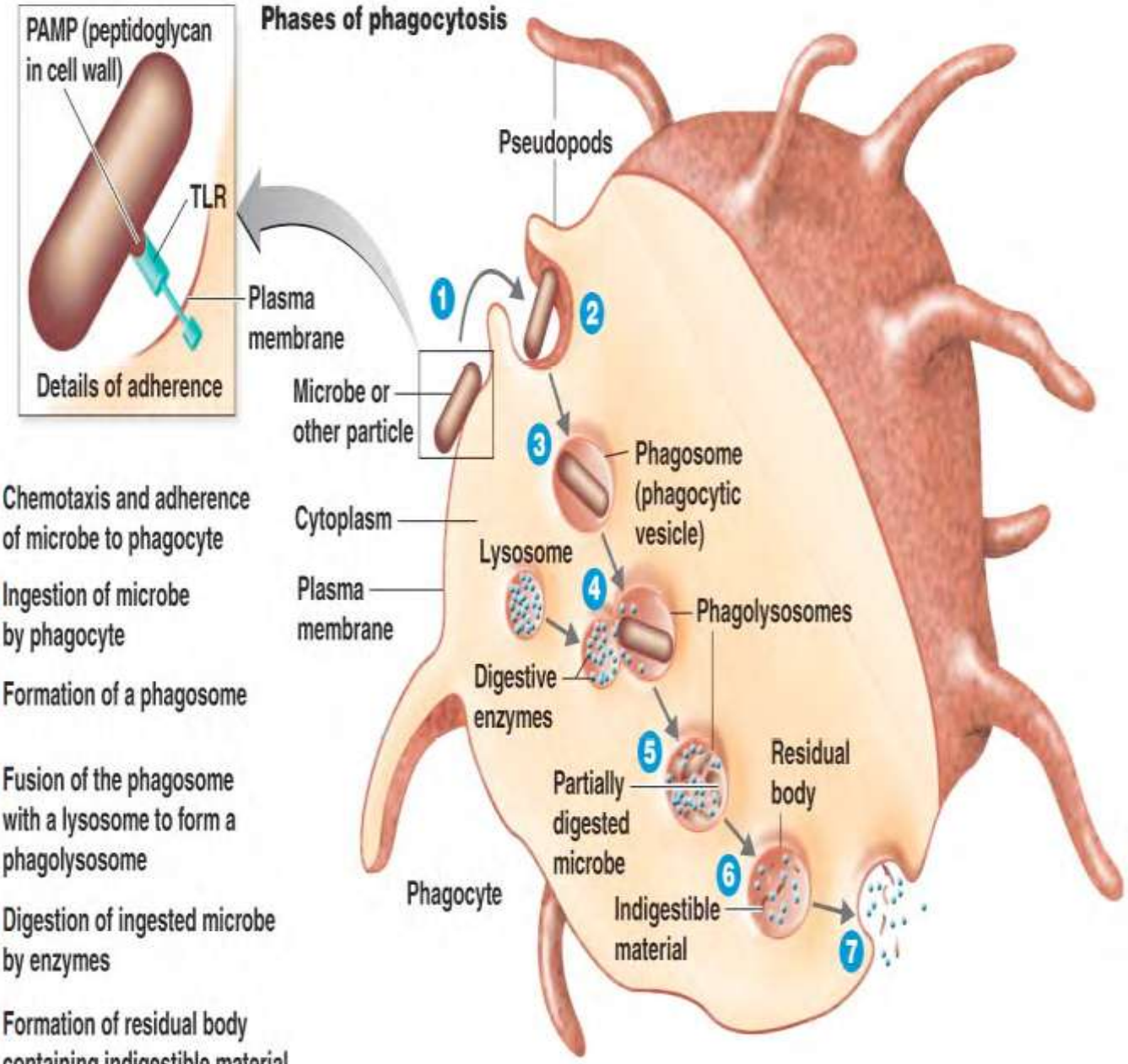
The Response to T-Dependent Antigens

- ❒ **B cells present antigen to effector T-helper cells**.
- ❒ Effector T-helper cell recognizes the antigen, it will **deliver cytokines**.
- ❒ Initiating the process of **clonal expansion**, which ultimately forms **plasma cells that produce antibody.**
- ❒ Under the direction of effector T-helper cells, the expanding B-cell population will undergo **affinity maturation and class switching, and form memory cells.**



Characteristic	**Innate Branch**	**Adaptive Branch**
Synonyms	Natural Nonspecific	Specific, acquired.
Mode of activation	Not applicable, present at birth	Acquired response to antigens
Inducible	No	Yes
Memory	No	Yes
Reaction time initiation,	Rapid 0-6 hours	Slow rapid thereafter
Phagocytosis	Yes	No
Includes various leukocytes	PMNs, monocytes, macrophages, eosinophil's, NK cells	Specific B cells , specific T cells
Specific antibodies	No	Yes
Includes the complement system	Yes	No
Includes physical barriers, skin and mucous membranes	Yes	No

Produces interferons	Yes	No
Lysozymein secretions	Yes	No
Induces fever	Yes	No
Causes inflammation	Yes	No



Key Concept

Phagocytes migrate to a site of infection and can destroy the infecting bacteria. The phases of phagocytosis are chemotaxis, adherence, ingestion, and digestion.