SAWA UNIVERSITY

المناعة 1

ANTIGENS

جامعـــــــة ســـــــــاوة الاهلية — Sawa University

كليـــــة التقنيـــات الصحيـة والطبيـة — College of health and medical techniques

قسم تقنيات المختبرات الطبية — Department of Medical Laboratories

المرحلـــــــــــــة الثالثة — Three Stage

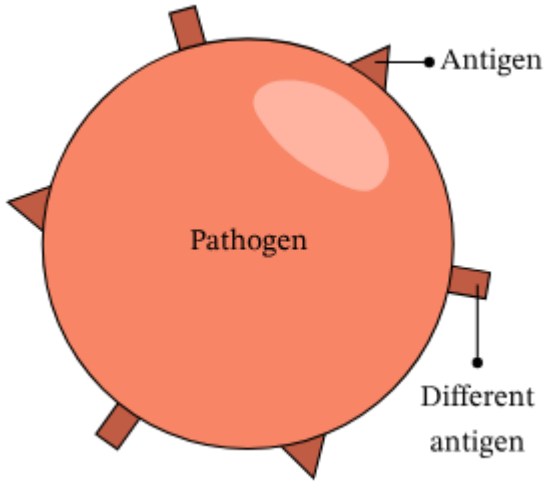
الجانب النظري — محاضرة رقم 4

Theoretical — Lecture No. 4

تدريسي المادة : د. زيدون حسين مهدي

Antigens

An antigen is any agent capable of binding specifically to components of the immune system, such as the B cell receptor (BCR) on B lymphocytes and soluble antibodies.



TYPES OF ANTIGEN ON THE BASIS OF THEIR ORIGIN

1. Exogenous antigens

• These antigens enter the body or system and start circulating in the body fluids and trapped by the APCs (Antigen processing cells such as macrophages, dendritic cells, etc.)

• The uptakes of these exogenous antigens by APCs are mainly mediated by the phagocytosis.

• Examples: bacteria, fungi etc.

2. Endogenous antigens

- Endogenous antigens exist on cells inside the body.
- These include cells that are infected with bacteria or a virus that mark themselves to be destroyed by the immune system.
- The endogenous antigens are processed by the macrophages which are later accepted by the cytotoxic T – cells.
- Examples: Blood group antigens, HLA (Histocompatibility Leukocyte antigens),etc

3. Autoantigens

• An autoantigen is usually a **normal protein** or **complex of proteins** (and sometimes DNA or RNA) that is recognized by the immune system of patients suffering from a specific autoimmune disease.

• These antigens should not be, under normal conditions, the target of the immune system, but, due mainly to genetic and environmental factors, the normal immunological tolerance for such an antigen has been lost in these patients.

• Examples: Nucleoproteins, Nucleic acids, etc.

Types of antigen according to the functional groups

1. Complete Antigen or Immunogen

• Possess antigenic properties, they are able to generate an immune response by themselves.

• High molecular weight (more than 10,000 Daltons).

• May be proteins or polysaccharides.

2. Incomplete Antigen or Hapten

• These are the foreign substance, usually non-protein substances unable to induce an immune response by itself, they require **carrier molecule** to act as a complete antigen.

• The carrier molecule is a non-antigenic component and helps in provoking the immune response. Example: Serum Protein such as Albumin or Globulin.

• Low Molecular Weight (Less than 10,000 Daltons)

• Haptens can react specifically with its corresponding antibody.

• Example: cardiolipin antigens.

HAPTEN: is essentially an incomplete antigen. These small molecules can elicit an immune response only when attached to a large carrier such as a protein; the carrier typically does not illicit an immune response by itself. Many hapten carriers are normal molecules that circulate through the body.

Haptens cannot independently bind to MHC complexes, so they cannot be presented to T cells.

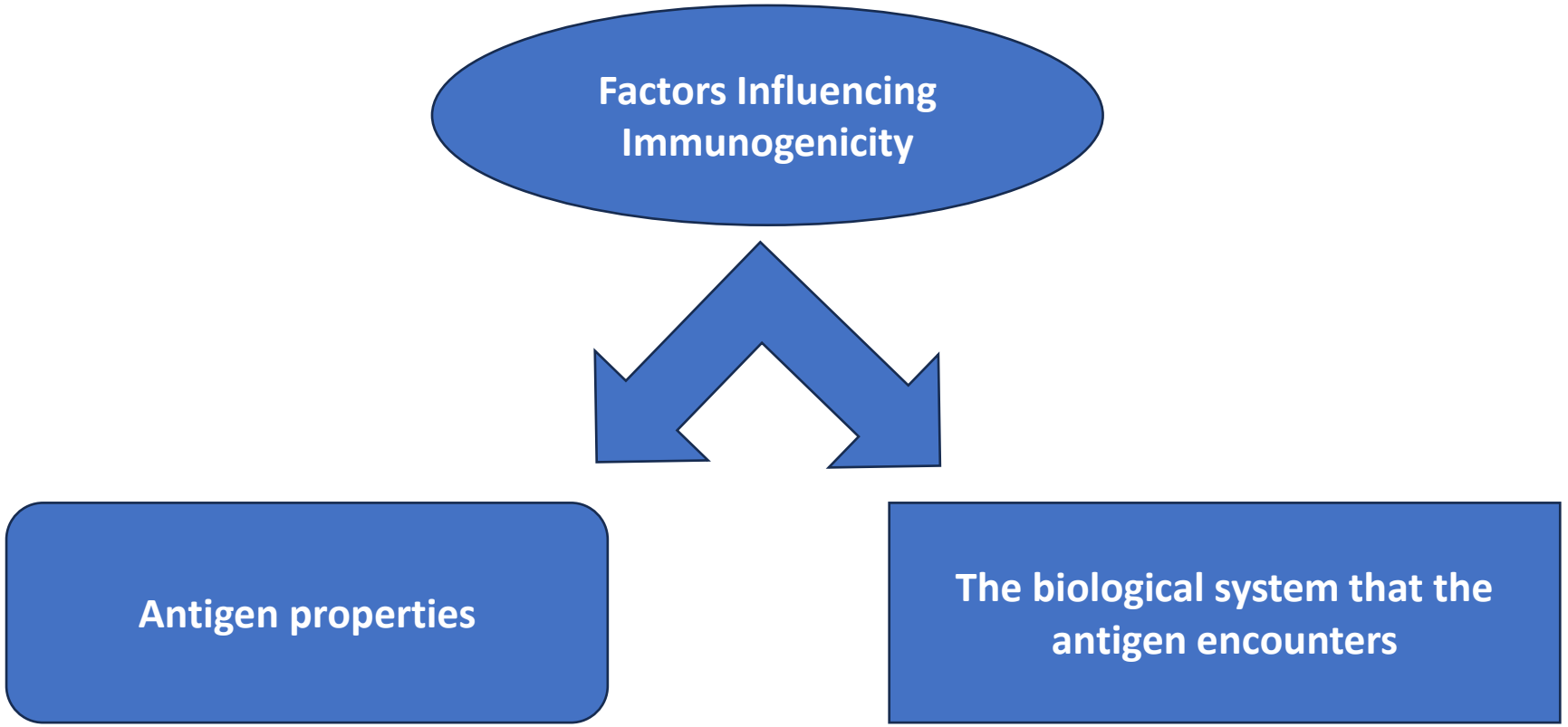
CARRIER MOLECULE: is a non-antigenic component that binds to haptens and helps in provoking the immune response.

Example: Serum Protein such as Albumin or Globulin.

3.Tolerogens:(usually self antigens):

- It is usually non immunogenic because it is self antigens.
- When self tolerance is removed, the tolerogens become immunogenic causing autoimmune diseases.

Factors Influencing Immunogenicity



Antigen properties

1. Foreignness

Antigens must be recognized as non-self by the immune system. **The degree of immunogenicity depends on the degree of foreignness**, i.e., The greater the phylogenetic distances between two species, the greater the structural (and therefore the antigenic) disparity between them. According to foreignness Ag classified to:

Autologous antigens: Antigens from the same individual. e.g. skin transplant from thigh to the face.

Syngenic antigens: Antigens from identical twins.

Allogenic antigens: Antigens from different individuals within the same species.

Xenogenic antigens: Antigens from different species.(transplant from sheep to horse).

2. Molecular Size

The most active immunogens tend to have a molecular mass of 14,000 to 6,00,000Da.

Examples: tetanus toxoid, egg albumin, thyroglobulin are highly antigenic. Insulin (5700) are either non-antigenic or weakly antigenic.

- Molecular Mass ≥ 1,00,000 Da: Active Immunogens
- Molecular Mass 5000-10,000 Da: Poor immunogens

3. Chemical Composition

In general, the more complex the substance is chemically the more immunogenic it will be.

Antigens are mainly **proteins** and some are **polysaccharides**.

- Starch and other simple repetitive polysaccharides are **poor antigens**.
- Complex bacterial lipopolysaccharides (LPS) are **good antigens**.
- Complex proteins are better antigens than large repeating polymers such as lipids, carbohydrates and nucleic acids

4. Degradability

Not all foreign molecules are capable of stimulating an immune response. e.g. stainless steel pins and plastic joints are implanted in the body without triggering an immune response.

The lack of antigenicity of the large, inert organic polymers is due to their molecular uniformity and their inertness.

Foreign molecules that are unstable and destroyed very rapidly may not provide sufficient antigen to stimulate an immune response.

The biological system (Host) that the antigen encounters

1. Genetic Factors

Some substances are immunogenic in one species but not in another .Similarly, some substances are immunogenic in one individual but not in others (i.e. responders and non-responders). The species or individuals may lack or have altered genes that code for the receptors for antigen on B cells and T cells.

2. Age

Usually the very young and the very old have a diminished ability to elicit and immune response in response to an immunogen.

3. Immunogen Dosage

An optimum dose is necessary to mount a good immune response. **An insufficient** dose will not stimulate an immune response (fails to activate enough lymphocytes or can induce a state of immunologic unresponsiveness or tolerance).

Excessively high dose induces tolerance. **Single-dose** will not induce a strong response.

4. Routes of Administration

Generally, the subcutaneous route is better than the intravenous or intra-gastric routes.

Route of administration strongly influences which immune organs and cell populations will be involved in the response. e.g., intravenous (spleen); subcutaneous (local lymph nodes).

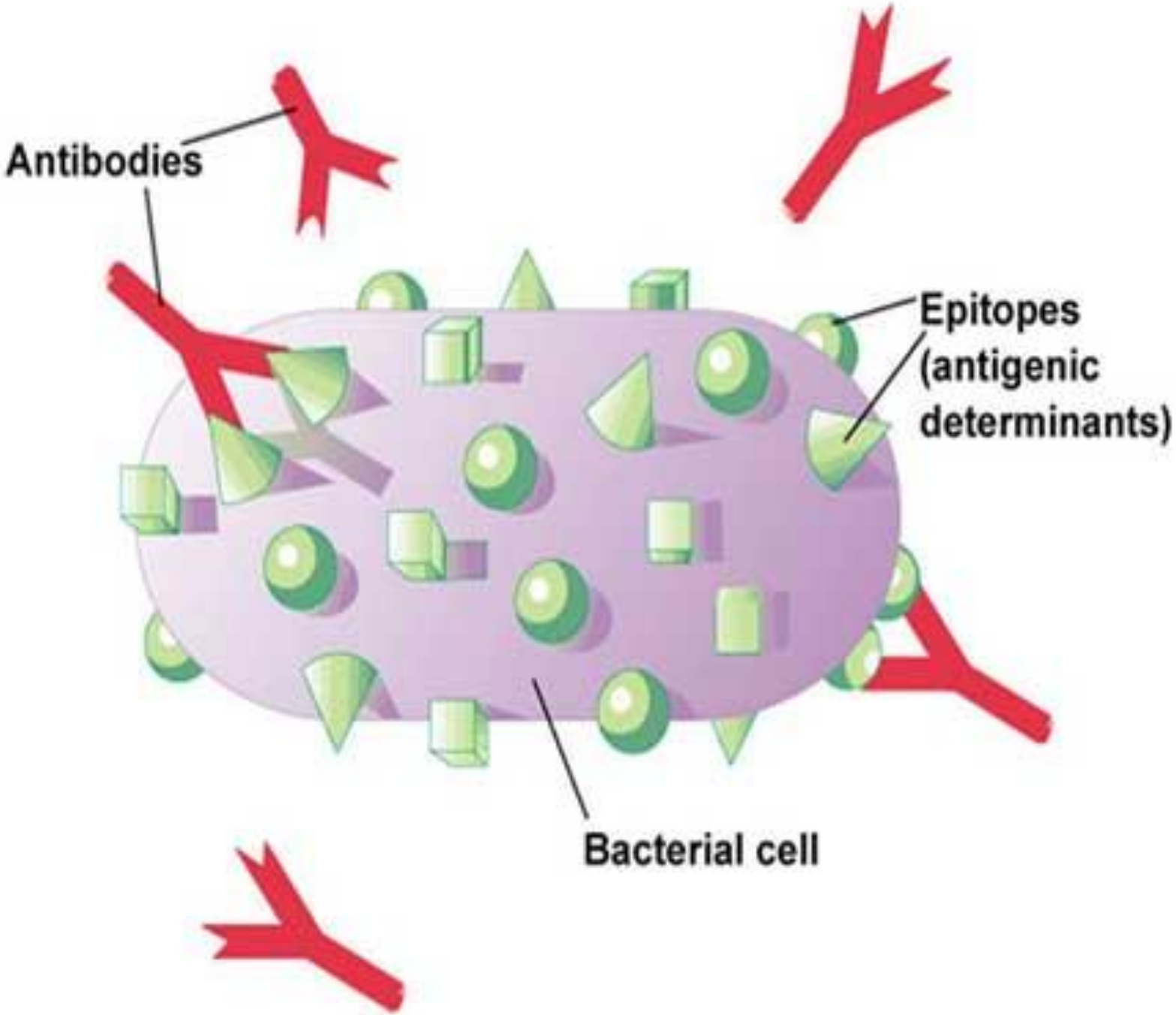
Structure of the antigen

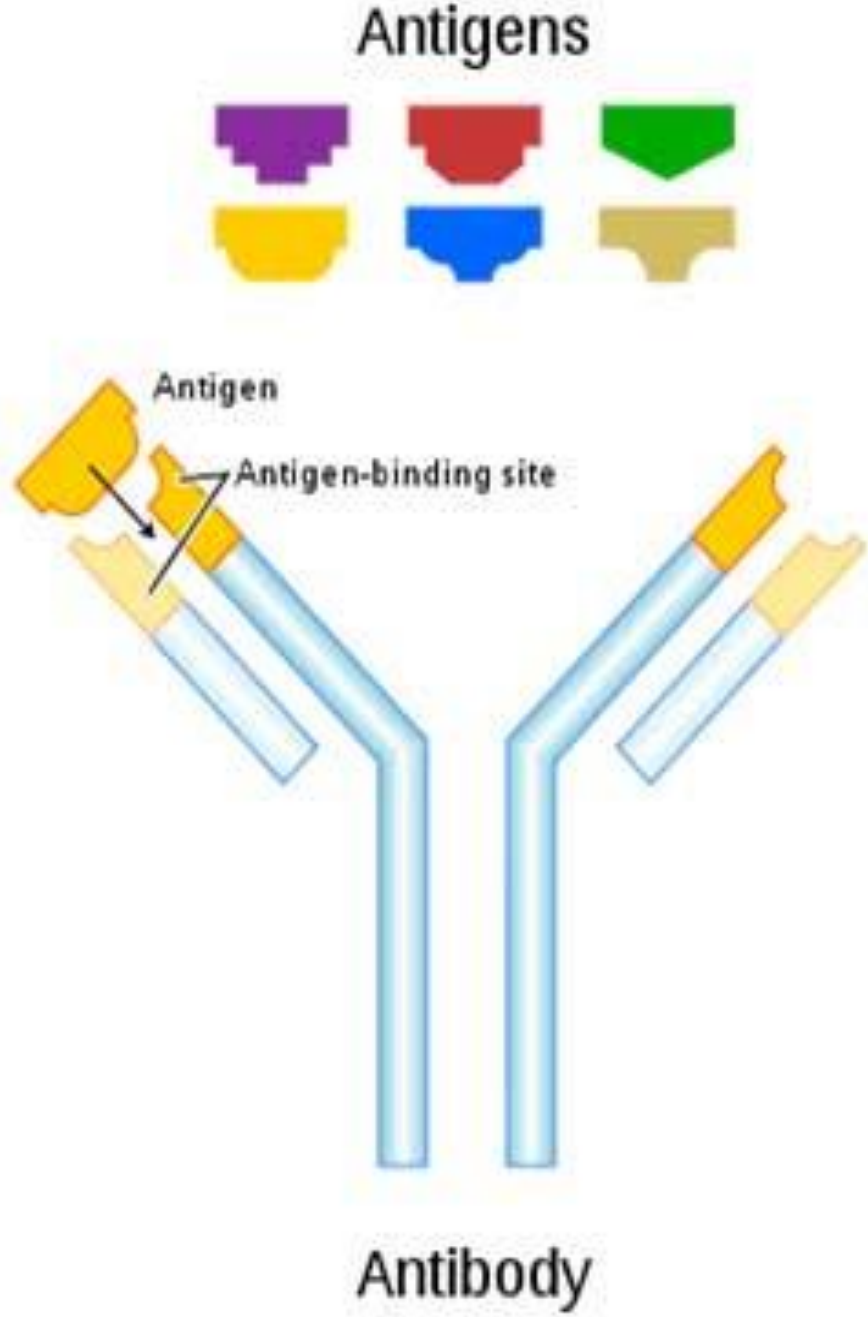
Epitope, also known as **antigenic determinant**: is the part of an antigen that is recognized by the immune system, specifically by antibodies, B cells, or T cells. For example, the epitope is the specific piece of the antigen that an antibody binds to. The part of an antibody that binds to the epitope is called a paratope.

Epitope is the part that determines the antigenicity of the antigen - thus the term "antigenic determinant". T and B cells recognize different epitopes on an antigen.

Epitope: the smallest unit of antigen that is recognized by immune cells, therefore it is also known as antigenic determinant .

- Epitope consists of 4-5 amino acid residues or monosaccharides.
- Posses a specific chemical structure and electric charge.
- One antigen may have a multiple type and copies of epitopes.
- Epitopes interact with paratope present on the antibody.


Antibodies
Epitopes
(antigenic
determinants)
Bacterial cell


Antigens
Antigen
Antigen-binding site
Antibody


Thank you!