ANTIGENS

ANTIGENS:- IS DEFINED AS AN ORGANISM, A MOLECULE, OR PART OF A MOLECULE THAT IS RECOGNIZED BY THE IMMUNE SYSTEM.

TYPES OF ANTIGEN:

ANTIGENS ARE CLASSIFIED INTO TWO TYPES: COMPLETE ANTIGEN AND HAPTEN

1- COMPLETE ANTIGEN (IMMUNOGEN) : A SUBSTANCE THAT INDUCES A SPECIFIC IMMUNE RESPONSE.

2- INCOMPLETE ANTIGEN (HAPTEN): HAPTENS ARE SMALL MOLECULES WHICH COULD NEVER INDUCE AN IMMUNE RESPONSE WHEN ADMINISTERED BY THEMSELVES BUT WHICH CAN WHEN COUPLED TO A CARRIER MOLECULE.

Antigenicity and Immunogenicity

Antigenicity is defined as the property of a substance **(antigen)** that allows it to

react with the products of a specific immune response **(antibody** or **T-cell receptor).**

Immunogenicity is defined as the property of a substance **(immunogen)** that endows it with the capacity to provoke a specific immune response.

FACTORS INFLUENCING IMMUNOGENICITY

A. Contribution of the Immunogen

1. Foreignness The immune system normally discriminates between self and nonself such that only foreign molecules are immunogenic.

2. Size The most potent immunogens are usually large proteins. Generally, molecules with a molecular weight less than 10,000 are weakly immunogenic.

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

4. Physical form In general particulate antigens are more immunogenic than soluble ones and denatured antigens more immunogenic than the native form.

5. Degradability Antigens that are easily phagocytosed are generally more immunogenic.

B. Contribution of the Biological System

1. Genetic Factors Some substances are immunogenic in one individual but not in others. The individuals may lack or have altered genes that code for the receptors for antigen on B cells and T cells.

2. Age Age can also influence immunogenicity. Usually the very young and the very old have a diminished ability to mount and immune response in response to an immunogen.

C. Method of Administration

1. Dose The dose of administration of an immunogen can influence its immunogenicity. There is a dose of antigen above or below which the immune response will not be optimal.

2. Route Generally the subcutaneous route is better than the intravenous or intragastric routes. The route of antigen administration can also alter the nature of the response

3. Adjuvants Substances that can enhance the immune response to an immunogen are called adjuvants. The use of adjuvants, however, is often hampered by undesirable side effects such as fever and inflammation.

CHEMICAL NATURE OF IMMUNOGENS

A. Proteins The vast majority of immunogens are proteins. These may be pure proteins or they may be glycoproteins or lipoproteins. In general, proteins are usually very good immunogens.

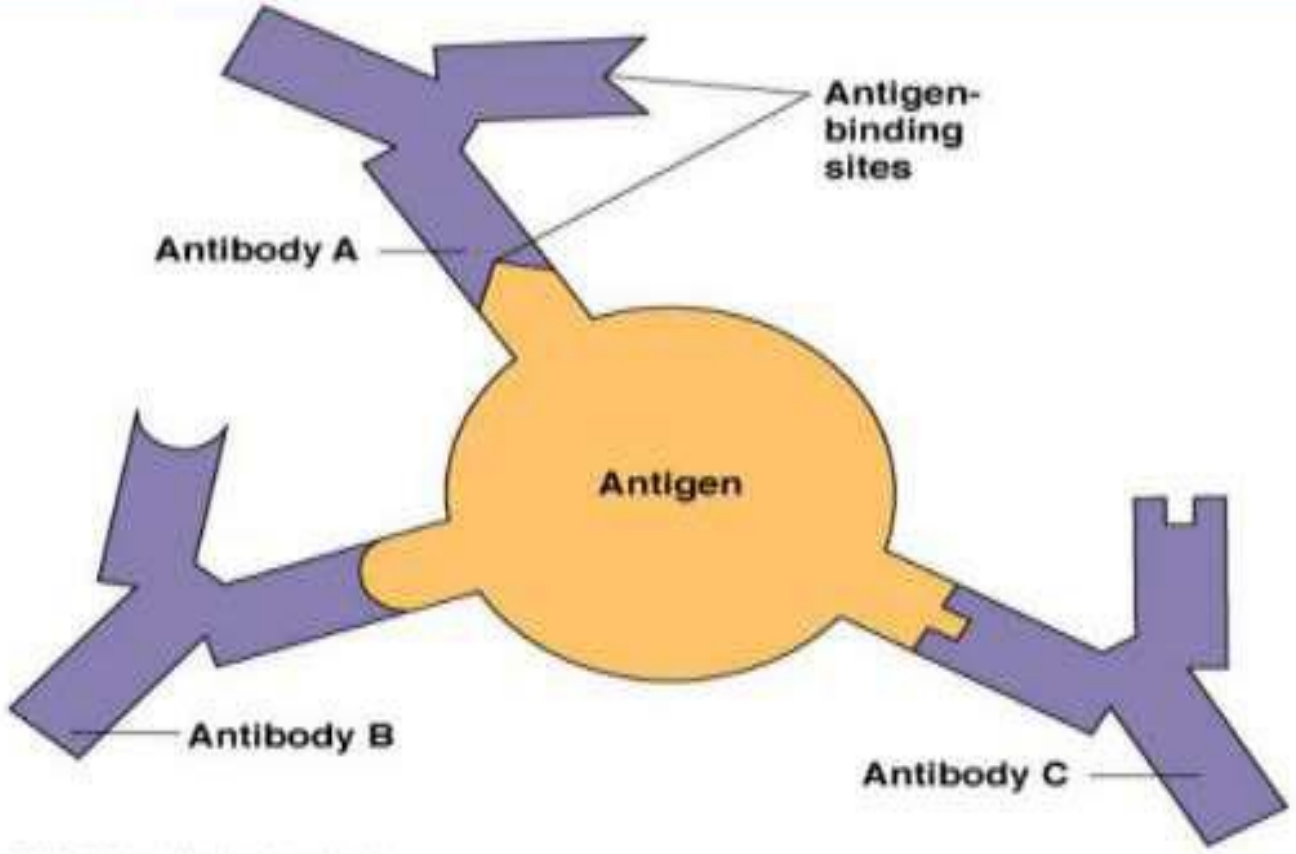
B. Polysaccharides Pure polysaccharides and lipopolysaccharides are good immunogens.

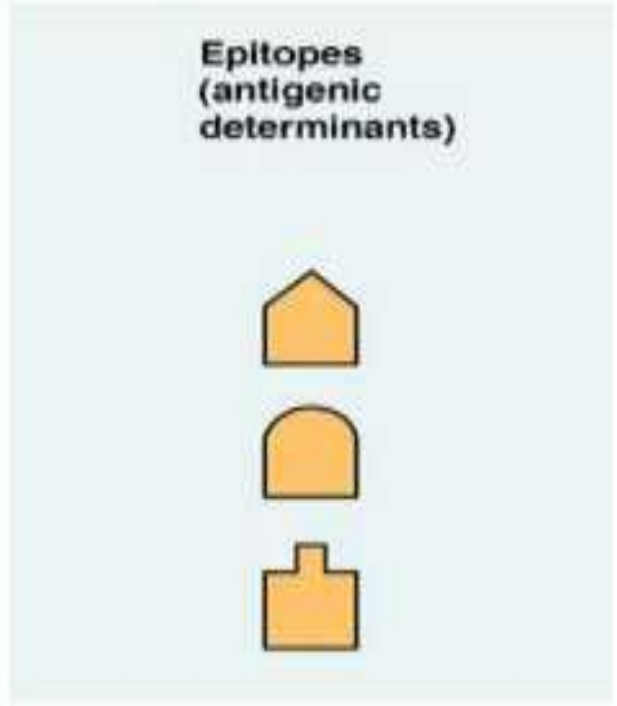
C. Nucleic Acids Nucleic acids are usually poorly immunogenic. However, they may become immunogenic when single stranded or when complexed with proteins.

D. Lipids In general lipids are non-immunogenic, although they may be haptens.

Epitope or Antigenic Determinant :An *epitope* is defined as the immunologically active region of an immunogen that binds to antigen-specific membrane receptors on lymphocytes or secreted antibodies.

Epitopes: Antigen Regions that Interact with paratopes, Antibodies regions





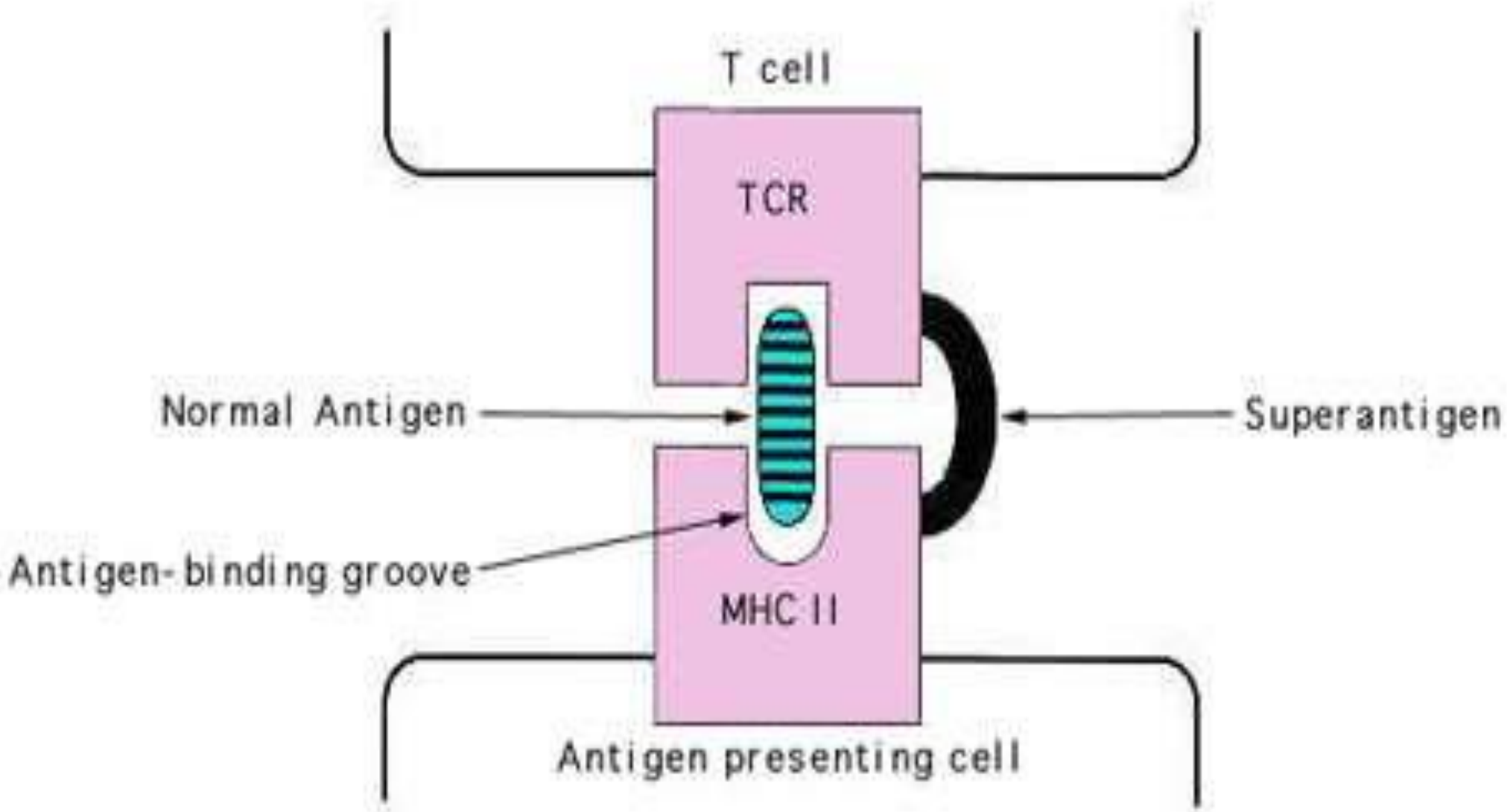
- **There are two types of epitopes**: B-cell epitopes and T-cell epitopes.

1-B-cell epitopes: B-cell epitopes are antigenic determinants recognized by B cells.

2- T-cell epitopes: T cells recognize amino acids in proteins but do not recognize polysaccharide or nucleic acid antigens. This is the reason why polysaccharides are considered as T-independent antigens and proteins as T-dependent antigens.

SUPERANTIGENS:

Superantigens are a class of molecules that can interact with APCs and T lymphocytes in a nonspecific way. The superantigens act differently by interacting with MHC class II molecules of the APC and the Vb domain of the T-lymphocyte receptor. This interaction results in the activation of a larger number of T cells (10%) than conventional antigens (1%), leading to massive cytokine expression and immunomodulation. Examples of superantigens are staphylococcal enterotoxins, toxic shock syndrome toxin, exfoliative toxins, and also some viral proteins


T cell
TCR
Normal Antigen
Superantigen
Antigen-binding groove
MHC II
Antigen presenting cell

Specificity Antigenic

The reaction between antigen and antibody is highly specific. An antigen reacts with its corresponding antibody only and vice-versa.

- Antigenic specificity depends upon the specific active sites on the antigen molecules i.e., antigenic determinants.
- The antigenic specificity is not absolute and cross –reactions may occur between similar or related antigens.
- The specificity of natural tissue antigens of animals may be considered under different categories, these are:

1- species specificity 2-isospecificity 3-Autospecificity

4-Organ specificity 5-Heterogenetic specificity

1- Species specificity: Tissue of all members in a species contain species specific antigen e.g. human blood proteins are antigenically diffierent from animal blood

proteins.

2- **Isospecificity**: Isoantigens, also known as alloantigens ,are antigens found in

some ,but not all members of a species. Based on the presence of different

isoantigens ,members of a species may be grouped into different groups. For

example ,human erythrocyte antigens –based on which individuals are classified

into different blood groups as A,B and O .

These antigens are genetically determined and are important in

- Blood transfusion
- Isoimmunization
- May provide valuable evidence in disputed paternity
- Also useful in anthropology.

Autospecificity: The autolgous or self –antigens are generally not antigenic ,but there are a few self –antigenis , which are not exposed to immune system because of their sequestered or hidden nature . for example , eye lens protein ,thyroglobulin ,etc., are anatomically confined to sites that prevent their contact with immune system , so they are not recognized as self- antigens

similarly ,the antigens that are absent during the embryonic life and appear in later life , e.g., sperms are also not recognized as self-antigens.

1-When these antigens are released into circulation following injury to eye lens or damage to thyroid or testis and come in contact with autoimmune disease.

2-The antigenic specificity of self-antigen may be altered as a result of infection ,irradiation or drug therapy and, hence, it may become immunogenic.

- **Organ specificity**

Organ specific antigens are antigens confined to a particular organ or tissue. Organs such as brain, kidney , thyroid, eye lens of one species share specificity with another species.

- **Heterogenetic or heterophile specificity**

The similar or closely related antigens present in different biological species, classes and kingdoms are known as heterogenetic or heterophile antigens.Antibodies to these closely related antigens produced by one species cross-react with antigens of other species.The best known example is the forssman antigen.It is a lipoprotien polysaccharide complex ,wich is widely distributed in humans, animals ,brids , plants and bacteria.