ANTIGENS

- **Antigen** is a substances usually protein in nature and sometimes polysaccharide or lipid, that generates a specific immune response and induces the formation of a specific antibody(Humoral Immunity) or specially sensitized T cells(Cell mediated immunity) or both.

EPITOPE/ANTIGENIC DETERMINANT

- The whole antigen does not evoke immune response and only a small part of it induces B and T cell response.
- The small area of chemical grouping on the antigen molecule that determines specific immune response and reacts specifically with antibody is called an antigenic determinant

ANTIGEN

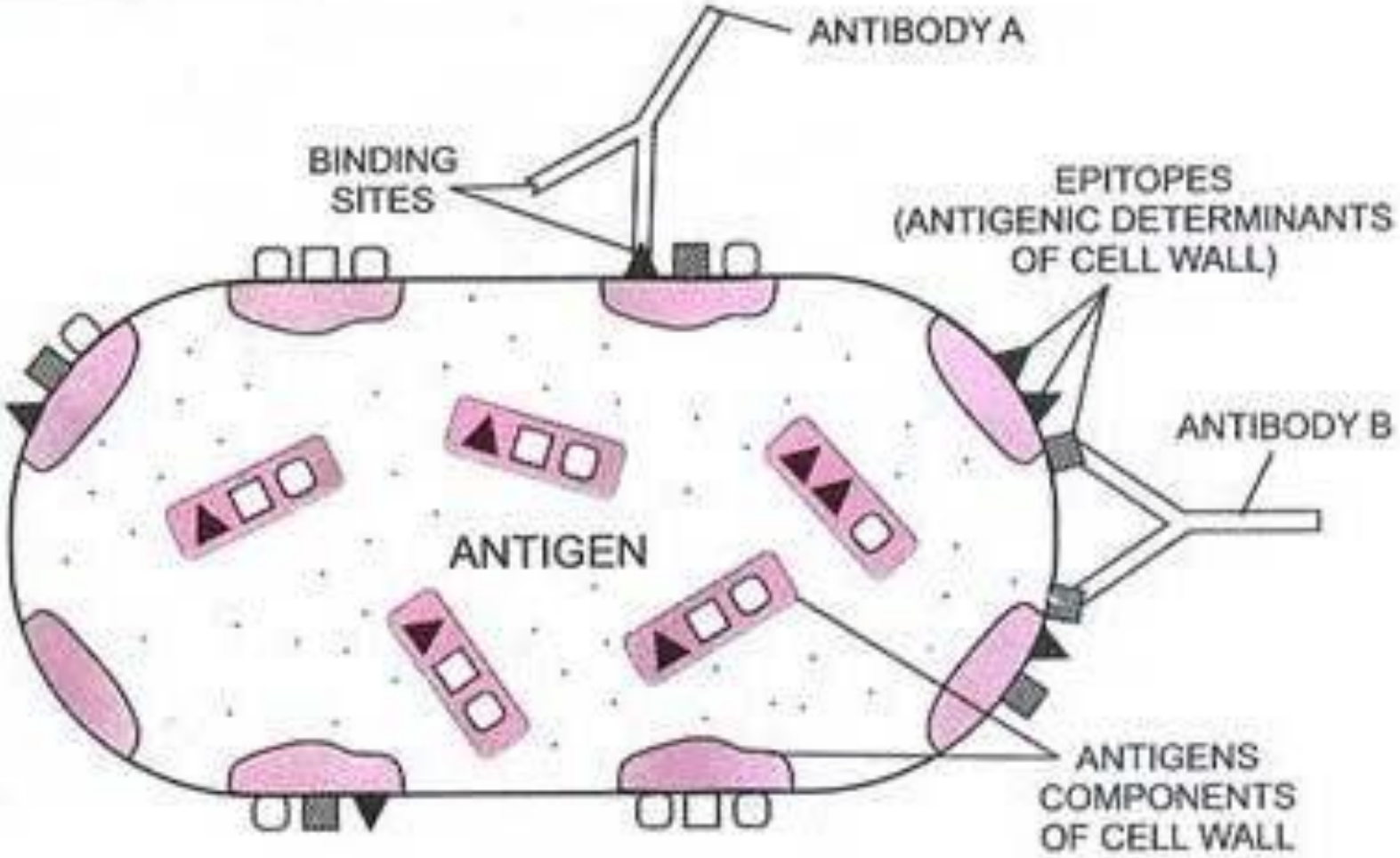


Diagram showing an antigen with epitopes (antigenic determinants). Two attached antibodies are also shown.\

IMMUNOGENICITY

- **Immunogenicity** is the ability of an antigen or epitope, to provoke an immune response in the body of a human and other animal.
- In other words, **immunogenicity** is the ability to induce a humoral and/or cell-mediated immune responses.
- A specific substance that induces a specific immune response is called an immunogen

ANTIGENICITY

- Antigenicity is the ability of a chemical structure (either an antigen or hapten) to bind specifically with T cell receptors or antibodies B cell receptors.
- All molecules that have the property of immunogenicity also have the property of antigenicity but the reverse is not true.

HAPTENS

Haptens, on the other hand, are antigenic but unable to induce antibody formation on its own but can become immunogenic i.e. capable of inducing antibodies, when covalently linked to proteins, called carrier proteins.

In other words haptens are non immunogenic.

- . Haptens can react specifically with induced antibodies. These antibodies are produced not only against haptens but also against the carrier proteins.

COMPLETE ANTIGENS

- ***Complete antigens*** are the substances which can induce antibody formation by themselves and can react specifically with these antibodies

PROPERTIES OF ANTIGENS

Physical Form

- In general large,insoluble or particulate antigens are more immunogenic than small,soluble one because large molecules are more readily phagocytosed and processed..
- Denatured antigens are more immunogenic than the native form.

PROPERTIES OF ANTIGENS

FOREIGNNESS

- The prerequisite for immunogenicity is that the substance should be foreign to the body of recipient. As a result the immune system must be able to distinguish between self and nonself proteins.
- Normally the body has ability to no recognize its own proteins , therefore does not initiate an immune response against these.

CHEMICAL COMPOSITION AND HETEROGENITY

- Homopolymers made up of multiple copies of a single amino acid or sugar are less immunogenic than heteropolymers.
- Chemical complexity of antigen contributes to immunogenicity.
- Primary,secondary,tertiary and quarternary contributes to structural complexity of a protein and affects immunogenicity.

PROPERTIES OF ANTIGENS

MOLECULAR WEIGHT

There is correlation between the size of a macromolecule and its immunogenicity.

- A molecule having a minimum size generally > 10000 Da can be considered as antigen.
- Generally, molecules with a molecular mass of less than 5000kDa are poor immunogens.
- Hence small molecules like amino acids or monosaccharides are usually not antigenic.

However, low molecular substance can demonstrate immunogenicity, if coupled to a suitable carrier molecule like protein.

CHEMICAL NATURE OF ANTIGENS

- **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.

PROPERTIES OF ANTIGENS

Antigen Specificity

- Antigen Specificity depends on the specific actives sites on the antigenic molecules (Antigenic determinants).

PROPERTIES OF ANTIGENS

Species Specificity

- Tissues of all individuals in a particular species possess, species specific antigen.
- Human Blood proteins can be differentiated from animal protein by specific antigen-antibody reaction.

PROPERTIES OF ANTIGENS

Organ Specificity

- Organ specific antigens are confined to particular organ or tissue.
- Certain proteins of brain, kidney, thyroglobulin and lens protein of one species share specificity with that of another species.

PROPERTIES OF ANTIGENS

Auto-specificity

- The autologous or self antigens are ordinarily not immunogenic, but under certain circumstances lens protein, thyroglobulin and others may act as ***autoantigens.***

PROPERTIES OF ANTIGENS

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.
- The species or individuals may lack or have altered genes that code for the receptors for antigen on B cells and T cells.
- They may not have the appropriate genes needed for the APC to present antigen to the helper T cells.

PROPERTIES OF ANTIGENS

Age

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

PROPERTIES OF ANTIGENS

Degradability

- Antigens that are easily phagocytosed are generally more immunogenic.
- This is because for most antigens (T-dependant antigens) the development of an immune response requires that the antigen be phagocytosed, processed and presented to helper T cells by an antigen presenting cell (APC).

PROPERTIES OF ANTIGENS

Dose of the antigen

- 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.
- An insufficient dose will not stimulate an effective immune response or may lead to immunotolerance.
- An excessively higher dose can also induce tolerance.
- Asingle dose may not be sufficient to induce strong immune response rather repeated booster doses are required.

ROUTES OF DOSAGE

The common routes of administration are

- 1. Intravenous – in vein
- 2.Intradermal- in the skin
- 3.Subcutaneous-beneath the skin
- 4.Intramuscular-into a muscle
- 5.Intraperitoneal-into the peritoneal cavity.

ROUTE OF ADMINISTRATION

Route of Administration

- 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.
- Antigen administered intravenously is carried first to the spleen, whereas antigen administered subcutaneously moves first to local lymph nodes.

ADJUVANTS

. Adjuvants

- Substances that when mixed with antigens and injected with it can enhance the immunogenicity of that antigen are called adjuvants.
- The use of adjuvants, however, is often hampered by undesirable side effects such as fever and inflammation.
- Example: aluminum potassium sulphate(alum),Freund;scomplete reagent and Freund incomplete adjuvant.

ADJUVANTS

- Adjuvants are used to enhance immunogenicity or when only small quantity of antigen is available.
- In general,adjuvants appear to exert one or more of the following effects;
- Antigen persistance is prolonged
- Costimulatory signals are enhanced.
- Local inflammation is increased.
- Non specific proliferation of lymphocytes is stimulated.

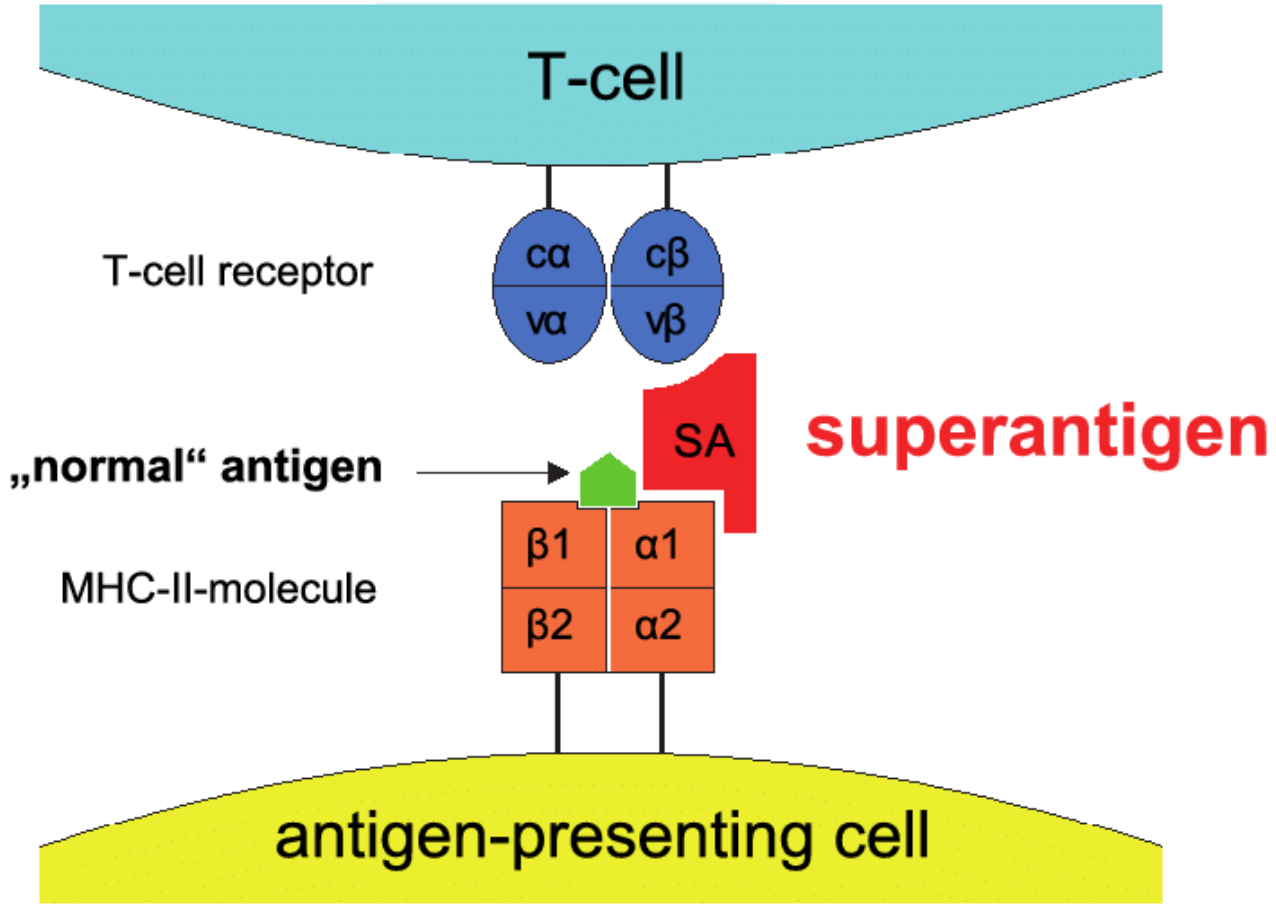
SUPERANTIGENS

- When the immune system encounters a conventional T-dependent antigen, only a very small fraction of the T cell population is able to recognize the antigen and become activated.
- However, there are some antigens which polyclonally activate a large fraction of the T cells (up to 25%). These antigens are called superantigens.
- Examples of superantigens include: Staphylococcal enterotoxins (food poisoning), Staphylococcal toxic shock toxin.

SUPERANTIGENS

- Superantigens are protein molecules that activates a very large number of T-cells irrespective of their antigenic specificity.
- Superantigens cause the release of cytokines which results in massive proliferation of T-lymphocytes.

SUPERANTIGEN



TYPES OF ANTIGENS

Exogenous antigens

- These antigens enters the body or system and start circulating in the body fluids and trapped by the APCs.
- The uptakes of these exogenous antigens by APCs are mainly mediated by the phagocytosis
- Examples: bacteria, viruses, fungi etc

TYPES OF ANTIGENS

Endogenous antigens

- These are body's own cells or sub fragments or compounds or the antigenic products that are produced.
- The endogenous antigens are processed by the macrophages which are later accepted by the cytotoxic T – cells.

Examples: Blood group antigens,HLA etc.

TYPES OF ANTIGENS

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.

CROSS REACTIVITY

- In some cases antibodies can bind to an antigen other than one which initiated antibody production. This is known as cross-reactivity.
- For example, the homologous ‘antigen a’ has induced production of the antibody specific for antigen a and cross-reacts with non-identical ‘antigen b.

CROSSREACTIVITY

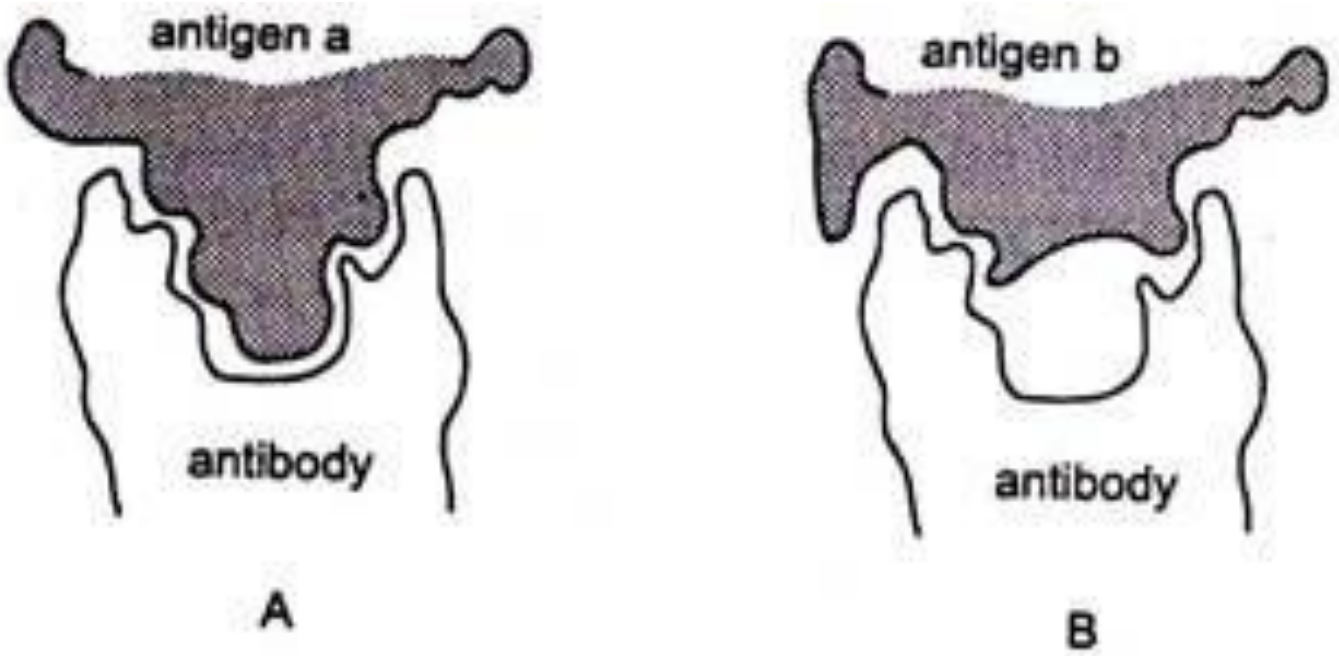


Fig.10.2 : Interaction of an antibody and a homologous (A) and cross reacting (B) antigens.

T-INDEPENDENT ANTIGENS

- Some antigens can directly stimulate antibody production by B cells, without the apparent participation of T cells. Such antigens are called ***T-cell independent antigens***. Most microbial Sugars, lipids and certain nucleic acid are T-cell independent antigens.

T- DEPENDANT ANTIGENS

- Most of the natural proteins are ***T dependent antigens*** and B cells cannot respond to these antigens without a Co-stimulatory signal from the T-helper ($T_{H)}$ cells.