ANTIGENS

I. **DEFINITIONS**

A. **Antigen (Ag)** - is any substance capable of binding specifically to components of immune response & this substance can reacts with the products of a specific immune response .

B- **Immunogen** - A substance that induces a specific immune response. immunogen have the property of antigenicity and immunogenicity. **Thus all immunogens are antigens, but not all antigens can to be immunogens**

C. **Haptens** are low molecular weight compounds that can combine with antibody but cannot initiate an immune response unless it is coupled to a larger **carrier** molecule.

A substance that is non-immunogenic but which can react with the products of a specific immune response. Free haptens have the property of antigenicity but not immunogenicity.

D. **Epitope or Antigenic Determinant** - That portion of an antigen that combines with the products of a specific immune response.

E. **Antibody (Ab)** - A specific protein which is produced in response to an immunogen and whichreacts with an antigen.

Requirements for immunogenicity

A. Contribution of the Immunogen

1. **Foreignness** - The immune system normally discriminates between self and non-self such that only foreign molecules are immunogenic.
2. **Size** - There is not absolute size above which a substance will be immunogenic. However, in general, the larger the molecule the more immunogenic it is likely to be.
3. **Chemical Composition** - In general, the more complex the substance is chemically the more immunogenic it will be. The antigenic determinants are created by the primary sequence of residues in the polymer and/or by the secondary, tertiary or quaternary structure of the molecule.
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. 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).

B. CHEMICAL NATURE OF IMMUNOGENS

1. **Proteins** -The vast majority of immunogens are proteins. . In general, proteins are usually very good immunogens. may be glycoproteins or lipoproteins become more immunogenic
2. **Polysaccharides** - Pure polysaccharides and lipopolysaccharides are good immunogens.
3. **Nucleic Acids** - Nucleic acids are usually poorly immunogenic. However they may become immunogenic when single stranded or when complexed with proteins.
4. **Lipids** - In general lipids are non-immunogenic, although they may be haptens.

C. Contribution of the Biological System

1. **Genetic Factors** - Some substances are immunogenic in one species but not in another. The species or individuals may lack or have altered genes that code for the receptors for antigen on B cells and T cells or they may not have the appropriate genes needed for the APC to present antigen to the helper T cells.

2 .**Age** - Age can also influence immunogenicity. Usually the very young and the very old have a diminished ability to enhances immune response compare with response of person in 20-30 years old

D. Contribution of the 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 compare with intra gastric 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.

Immunological adjuvants

To enhance the immune response to a given immunogen, various **additives** or **vehicles** are often used. An **adjuvant** is a substance that, when mixed with an immunogen, enhances the immune response against the immunogen.

Adjuvant name	Composition	Mechanism of action
Incomplete Freund's adjuvants	Oil in water emulsion	Delayed release of antigen; enhanced uptake by macrophage
Complete Freund's adjuvants	Oil in water emulsion with dead mycobacteria	Delayed release of antigen; enhanced uptake and induction of co-stimulators in macrophages

TYPES OF ANTIGENS

A. **T-independent Antigens** - T-independent antigens are antigens which can directly stimulate the B cells to produce antibody without the requirement for T cell help In general, polysaccharides are T-independent antigens. The responses to these antigens differ from the responses to other antigens.

B. **T-dependent Antigens** - T-dependent antigens are those that do not directly stimulate the production of antibody without the help of T cells. Proteins are T-dependent antigens.Structurally these antigens are characterized by a few copies of many different antigenic determinants .

Major Histocompatibility Molecules

The major histocompatibility complex (MHC) , also called the human leukocyte antigen (H LA) complex, is a segment of

chromosome 6 containing several genes that are critical to immune function, polypeptide molecules.
The major histocompatibility complex (MHC) encodes class I and II molecules, which function in antigen presentation to T cells, and class III molecules, which have diverse functions.
MHC class I molecules

are found on the surfaces of all nucleated cells. Peptide presented to CD8+T cells.

M H C class II molecules are normally expressed only on dendritic, macrophage, and 8-cell surfaces, on some activated T cells, and on some specialized epithelial cells in the thymus and intestine. Peptide presented to CD4+T cells.

Functions:

1. **Participates in the adaptive immune response serving as antigen presenting molecules.**
2. **Participates in the innate immunity serving as regulatory molecules:Complement reactions,regulate NK cells,Intiate and control on inflammation.**

Allograft Rejection

The clinical significance of the MHC is realized in organ transplantation. Cells and tissues are routinely transplanted as a treatment for a number of diseases. However, reaction of the host against alloantigens of the graft (HVG) results in its rejection and is the major obstacle in organ transplantation. The rejection time of a graft may vary with the antigenic nature of the graft and the immune status of the host and is determined by the immune mechanisms .