

ANTIGENS- General properties structure and function,variability and diversity

Antigen defined as any **foreign** substance that elicits an immune response when introduced into tissues of an animal . Antigens are generally of high molecular weight and commonly are proteins or polysaccharides . Antigen that elicit strong immune response are said to be immunogenic.

Types

Exogenous antigen - antigen entering from outside body by inhalation,injection,

Endogenous antigen - which generated inside the body. They produced by virus.

Self antigens - the antigens of one's own body.

Tumor antigens - the antigens which present on the surface of tumor cells.

Characters of good antigen

- 1.Areas of structural stability and chemical complexity with in the molecule.
2. Significant stretches and lacking extendice repeating units.
3. Minimal molecular wt is 8000-10000 daltons.
4. Ability to be processed by immune system.

Structure and function

A small site of an antigen to which a complementary antibody may specifically bind is called **epitope**. Other wise called antigenic determinant. The portion of antibody molecule that bind to epitope ls called **paratope**.

Epitope is usually **1-6 monosaccharides or 5-8 amino acids residues** on surface of antigen. Because antigen molecule exists in space,the epitope recognised by antibody may be dependent upon the presence of specific 3D conformation or epitope may correspond to a simple primary sequence region. Such epitopes are called conformational or linear respectively.

In their natural environment form they may be cytoplasmic membrane associated or secreted.

The number of location and size of epitope depend on how much of antigen is presented during antibody making process.

Chemical nature of antigens and antigenic determinants

Substances of different chemical nature serve as antigen. Heavy metals such as **Ni** and small organic compounds like dinitrophenol may function as **haptens**. while proteins, polysaccharides, lipoproteins, nucleoproteins may function as complete antigen .

Variability

Based on ability to induce immune response antigen classified into two.

Complete antigen - an antigen is said to be complete when it can both induce an immune response and can react with the product of that immune response.

Incomplete antigen - also called **haptens**. They can combine with antibody but can't initiate an immune response not immunogenic by itself. The word haptens means to bind. Haptens become immunogenic when combine with larger molecule namely carrier .

Diversity

Natural antigens versus artificial antigens

natural antigens are everywhere. They are in water ,air and food. Most are harmless but when exposed to significant amount of these cause immune response. Most common source of natural antigen is the microbial world.

Incase where microbes are virulent and cause life threatening disease,it is best to help host to acquire specific immunity.so microbiologist have developed vaccines to immunise the population, in a sense exposing people to an artificial antigen.

Soluble versus cellular antigen

antigens may be soluble macromolecules or part of particle or cell. In most cases it is necessary for antigen to be taken up by macrophages and partially degraded into immunogenic peptide before presentation of immune lymphocytes.

Incase of immune response of cellular antigens,there will be protective ,since antibodies don't penetrate living cells.

Thymus dependent and thymus independent antigen

most antigens are dependent upon T cell for their ability to induce an immune response,while others can antibody response with T cell help. Most antigens are thymus dependent because B cells can't respond to them unless they receive help from T cells. Thus the response to thymus dependent antigens involves the interaction of Th and B cells.

Some polymer antigens such as bacterial proteins, polysaccharides can directly stimulate B cells to produce antibody without they stimulate B cells to produce antibody without assistance of the cells. This is because they have multiple epitopes capable of directly interacting with B cells receptors this activating B cell growth and differentiation. such antigens are said to be thymus independent .

Factors affecting antigenicity

Foreignness

In order to elicit an immune response a molecule must be recognised as non self by biological systems. Antigens that are not exposed to immature lymphocytes during critical period may be later recognised as non self. When an antigen exposed to an organism the degree of immunogenicity depend on degree of its foreignness.

Molecular size

- Most active immunogens have mol.wt of 100000 daltons
- Small mol. like dinitrophenyl does not evoke antibody response
- Most potent immunogens have mol.wt of 10000 and above

Immunogen dosage and route administration

- Each immunogen exhibit a particular dose response curve which is determined by measuring the immune response to different doses and administration route .
- Insufficient dose will not stimulate immune response .
- Repeated administration or booster dose increase the clonal proliferation by antigen specific T cells or B cells

Common administration route

- Intravenous - into the vein
- Intradermal - into skin
- Subcutaneous - beneath skin
- Intramuscular - into muscle

Species specificity

- Tissue of all individuals in a particular species possess species specific antigen.

- Human blood products has specific antigen antibody

Auto specificity

Autologous or self antigen are ordinarily not immunogenic but under certain circumstances thyroglobulin may act as autoantigens.

Chemical composition

Proteins are more immunogenic than Polysaccharides ,while lipids are the least.

Genetic factors

Substance are immunogenic in one species but not in another

Similarly some substances are immunogenic in one individual but not in others

Age

Age usually very young and very old have a diminished to elicit an immune response

Degradability

Antigens that are easily phagocytosed are generally more immunogenic

Adjuvants

Substance that can enhance the immune response to an immunogen are called adjuvants

Use of adjuvants have undesirable side effect such ad fever and inflammation

EPITOPES

Smallest unit of antigenicity is known as epitopes. It is bind to the antibody. Depending on the size of antigen molecule there may be several epitopes in same antigen molecule. Some times it is composed of string of aminoacids.

The part of antibody attaches to the epitope is **called paratope** .

Epitope and paratope is determine the specificity of immunological reaction.

HAPTENS

Haptens are low molecular weight substance which cannot induce immunological response. They are incapable of inducing antibody formation.

The term hapten introduced by **Karl landsteiner**

Eg. penicilin acts as haptens

ADJUVENTS

Adjuvants are the substance that enhance the immune response administered along with antigen. It provide increased immunity particular disease . It produce more robust immune response better than the one antigen can produce alone.

It enhance cell mediated and humoral response.

Adjuvants can be divided on the basis they used such as - prophylatic purpose and experimental purpose

Prophylatic adjuvants are used for the production of therapeutic vaccines. They induce protective immune response against infectious substances it minimal side effects
They are economical ,stable and easy for admistration.

Experimental adjuvants are used for experimental purpose. Eg.production of polyclonal antibody
They activate innate immune response.

Mechanism of action

Formation of depot antigen
Induce formation cytokines
Recruitment of immune cells
Enhancement of antigen uptake and presentation

Eg. Aluminum pottasium sulphate, aluminum phospate and aluminium hydroxide
Oil based adjuvent used in human vaccine

Benefits of adjuvants

- Rapid response to pathogen
- Vaccine response broadening
- Vaccines for elderly
- Therapeutic vaccine
- New T cell vaccine
- Reduced number of immunisation

