

ANTIGENS & IMMUNOGENS

By Bishwanath Barat

Antigens are defined specifically as molecules that interact with the Immunoglobulin (Ig) receptor of B cells or with T cell receptors when complexed with MHC (Major Histocompatibility Complex).

Antibodies can recognize as antigens almost every kind of biologic molecule, including simple intermediary metabolites, sugars, lipids, autacoids, & hormones, as well as macromolecules such as complex carbohydrates, phospholipids, nucleic acids, & proteins.

DEFINITION (BRIEF DISCUSSION) OF SOME TERMS RELATED TO ANTIGENS:-

- 1) **Epitopes or Antigenic Determinant sites:-** Epitopes are the sites or regions on the antigen molecule that bind to a specific antibody or TCR.
Antibodies are formed most readily in response to epitopes that project from the foreign molecule or to terminal residues of a specific polymer chain. Chemically, epitopes include sugars, organic acids & bases, amino acid side chains, hydrocarbons & aromatic groups. In addition, it has been revealed that B & T cells recognize different sites on the same antigen molecule.
- 2) **Valence:-** The number of epitopes on the surface of an antigen is called its valence.
The valence determines the number of antibody molecules that can combine with the antigen at a time. If one determinant site is present, the antigen is called monovalent. Most antigens, however, have more than one copy of the same epitope & are termed multivalent. Infact, multivalent antigens generally elicit a stronger immune response than do monovalent antigens.
- 3) **Immunogen, Immunogenicity & Antigenicity:-** A substance that induces a specific immune response is appropriately called an immunogen (immunity generator).
Immunogenicity is the ability to induce a humoral &/ cell mediated immune response.
B cells + antigen → effector B cells + memory B cells

↓

Plasma cell → secretes antibody

T cells + antigen → effector T cells + memory T cells

↓

CTLs, T_H, etc. → secretes cytokines & cytotoxic factors

Antigenicity is the ability to combine specifically with the final products of immune responses (i.e. antibodies &/ cell surface receptors).

N.B.: Although all molecules that have the property of immunogenicity also have the property of antigenicity, the reverse is not true.

4) **Haptens :-** Many small organic molecules are not antigenic by themselves but become antigenic if they bond to carrier molecule such as a protein. These small antigens are called haptens [Latin haptain, to grasp].

N.B. For details, refer note on haptens.

5) **Tolerogen:-** These are the antigens that induce tolerance. They are so called to distinguish them from immunogens, which generate immunity.



The same chemical compound can be both an immunogen & a tolerogen, depending on how it is presented to the immune system. The various factors that promote tolerance are- (i) high doses of antigen; (ii) persistence of antigen in host; (iii) intravenous or oral introduction; (iv) absence of adjuvants; (v) low levels of co-stimulators.

Tolerogenic forms of antigens include large doses of the proteins administered without adjuvants, Altered Peptide Ligands (APLs), & orally administered antigens.

6) Superantigens: - Several bacterial & viral proteins can provoke a drastic & harmful response when they are exposed to T cells. These superantigens non-specifically stimulate T cells to proliferate by interacting with both Class II MHC molecules on APCs & TCR (β domain) outside of the antigen binding site. This binding allows many different T cells with different TCRs to become activated. Superantigens cause symptoms by stimulating the release of massive quantities of cytokines (like $\text{TNF-}\alpha$, IL-1 & IL-6) from CD4^+ T cells.

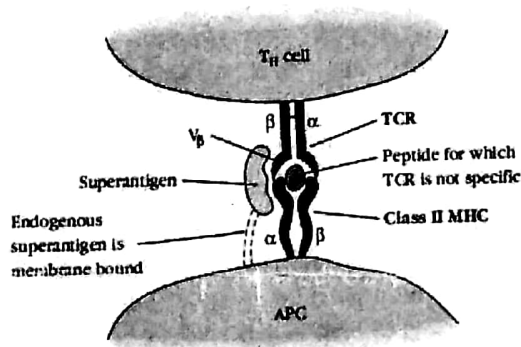


Fig. Superantigen mediated cross-linkage of TCR &

Class II MHC molecules.

7) Tumor Antigens: - An antigen whose expression is restricted to a particular tumor & is not expressed by normal cells are called tumor antigens

Two types of tumor antigens have been identified on tumor cells. They are- a) Tumor Specific Transplantation Antigens (TSTAs) & b) Tumor Associated Transplantation Antigens (TATAs).

TSTAs are unique to tumor cells & do not occur on normal cells in the body. They may result from mutations in tumor cells that generate cellular proteins; cytosolic processing of these proteins would give rise to novel peptides that are presented with Class I MHC molecules, inducing a cell mediated response by tumor-specific CTLs.

On the otherhand, TATAs, which are not unique to tumor cells, may be proteins that are expressed on normal cells during fetal development when the immune system is immature & unable to respond but that are not expressed in the adult.

8) Allergens:- An antigen that elicits an immediate hypersensitivity (allergic) reactions. Allergens are proteins or chemicals bound to proteins that induce IgE antibody responses in atopic (a hereditary predisposition to the development of immediate hypersensitivity reactions against common environmental antigens) individuals.

