A study material for M.Sc. Biochemistry (Semester: III) Students
on the topic (CC-12; Unit II)

Antigens and Immunogens

The foreign particles

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Antigens

Original definition: any substance that could induce the generation of antibodies

- These can be proteins, carbohydrates, lipids, nucleic acids, or combinations of these

Current definition: any molecule that can bind specifically to an antibody or to antigen receptors on cells of the immune system

- We are primarily interested in whether an antigen can induce an immune response

There are four types of antigens, classified by how they affect the immune system

- Immunogens
- Haptens
- Tolerogens
- Mitogens

Immunogens

- Immune response generator—can bind *and* induce an immune response
- The immunogen is the target of the response it induces
- Subsequent exposures result in increased responsiveness
- Proteins tend to be more immunogenic than lipids, carbohydrates, and nucleic acids
- Important for vaccines

Immunogenecity vs Antigenicity

- Immunogenicity is the ability to induce a humoral and/or cell-mediated immune response.

B cells + antigen ⟶ effector B cells + memory B cells

T cells + antigen ⟶ effector T cells + memory T cells

- Antigenicity is the ability to combine specifically with the final products of the **immune response** (i.e. secreted antibodies and/or surface receptors on T-cells).

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

FACTORS INFLUENCING IMMUNOGENICITY

- **Size** (the bigger the better)
  - **haptens**: antigens that can not provoke an immune response because of their small size unless they are attached to a carrier molecule (e.g. a self peptide)
- **Genetics**
  - Species (evolutionary the farther the better)
  - Individual (e.g. transplantation antigens)
- **Age** (young: immature, old: decreasing number of lymphocytes)
- **Dose**
- **Route** (vaccination)
  subcutaneous > intravenous > oral / intranasal
  Not true for live vaccines (e.g. oral polio vaccine)
- **Adjuvant** (vaccination)
  - substances that **enhance the immune response to an antigen** (aluminum salts, LPS, Freund's adjuvant, TLR ligands)
  - **depot effect** – slower biodegradation, prolonged antigen intake by antigen presenting cells
  - **activation of innate immunity**
- **Physical status**
  - corpuscle (cell, colloid) or soluble
  - denatured or native
- **Degradability**
  antigen presentation by APCs

Antigenic Determinants or Epitopes

- ***DEFINITION:***
  - immunologically active regions of an immunogen that interacts with the specific antigen binding site in the variable region of the antibody molecule (***PARATOPE***) or to secreted antibodies
    - EXCELLENT FIT between epitope and paratope: based upon their *3-D interaction and non covalent union*
  - are discrete site on the macromolecule recognized by the lymphocytes (B-lymphocytes/ T-lymphocytes)
  - ***NOTE***: B and T cells recognize DIFFERENT epitopes on the SAME antigenic molecule
  - ***THUS***: the ability to function as a B-cell epitope is determined by the nature of the ***ANTIGEN-BINDING*** site of the antibody molecules DISPLAYED by B-cells

EPITOPE VERSUS PARATOPE

EPITOPE	PARATOPE
The part of an antigen molecule to which an antibody attaches itself	The part of the molecule of an antibody that binds to an antigen
AKA: Antigenic determinant	AKA: Antigen-binding site
Occurs on both self or non-self antigens	Occurs on antibodies
Binds to the paratope on antibodies and receptors on both B and T cells	Binds to the epitopes
Helps to discriminate between self and non-self	Helps to recognize specific antigens to trigger a humoral immune response

Acknowledgement and Suggested Readings:

1. Kuby Immunology; Sixth Edition; Kindt, Goldsby and Osborne; W. H. Freeman and Company
2. Fundamental Immunology; 5th edition; William E., Md. Paul (Editor) ; Lippincott Williams & Wilkins Publishers
3. Roitt's Essential Immunology; Tenth Edition; Roitt and Delves; Blackwell Science
4. Cellular and Molecular Immunology; 6th Edition; Abbas, Lichtman and Pillai; Saunders Elsevier

Thanks