

# Lecture 13

## 29 Aug 2023

# Determinants of Antigenicity

- Properties which make a substance antigenic:
  - Size
  - Nature of Ag
  - Foreignness
  - Susceptibility to tissue enzymes.
  - Exposure to the Ag.

## Determinants of antigenicity...

### 1. Size

- Large molecules are highly antigenic.
- Low mol.wt. (<5000 Da) substances are weakly antigenic or non antigenic.
  - ✓ Can be made antigenic by conjugation to a carrier (protein or other biomacromolecule) in order to stimulate an immune response on immunisation of a host animal

### 2. Nature of the Ag

- Macromolecular proteins are the most potent immunogens.
- Polysaccharides, glycoproteins, synthetic polypeptides, lipids and nucleic acids are less immunogenic
- Antigenicity can be enhanced by conjugating to a protein.

## Determinants of antigenicity...

### 3. Foreignness

- Ags which are 'foreign' to the individual induce an immune response.
- Antigenicity is related to the degree of foreignness - Ags from other individuals of the same species are less antigenic than those from other species.

### 4. Susceptibility to tissue enzymes

- Substances which are rapidly metabolised & are susceptible to the action of tissue enzymes behave as more potent Ags.
- Ags are degraded into fragments of appropriate size containing the epitope.
- Degradation is brought about by phagocytosis & the intracellular enzymes.

## Determinants of antigenicity...

### 5. Exposure to the Ag

- Dose of the immunogen : optimum dose
- Lower or higher than the optimum can induce tolerance (inability to induce an immune response)
- Route of administration
- Immune response can be increased by mixing the Ag with a powerful adjuvant.

#### Adjuvants:

- Substances which are added to or emulsified with an Ag so as to enhance the Ab production.
- They can be - Inorganic salts : Alum; Organic: like BCG
  - Bacterial products: *Bordetella pertussis* (with Diphtheria, Tetanus toxoids)

# Mechanism of adjuvants

- Ag persistence is prolonged
- Improves the Ag process and presentation ability of macrophages
- Non-specifically stimulate proliferation of lymphocytes
- Local inflammation is increased

**TABLE 3-3** Postulated mode of action of some commonly used adjuvants

Adjuvant	POSTULATED MODE OF ACTION			
	Prolongs antigen persistence	Enhances co-stimulatory signal	Induces granuloma formation	Stimulates lymphocytes nonspecifically
Freund's incomplete adjuvant	+	+	+	—
Freund's complete adjuvant	+	++	++	—
Aluminum potassium sulfate (alum)	+	?	+	—
<i>Mycobacterium tuberculosis</i>	—	?	+	—
<i>Bordetella pertussis</i>	—	?	—	+
Bacterial lipopolysaccharide (LPS)	—	+	—	+
Synthetic polynucleotides (poly IC/poly AU)	—	?	—	+

## Common adjuvants:

Freund's adjuvant is a solution of antigen emulsified in mineral oil and used as an immunopotentiator (booster). Two types:

-Incomplete Freund's adjuvant

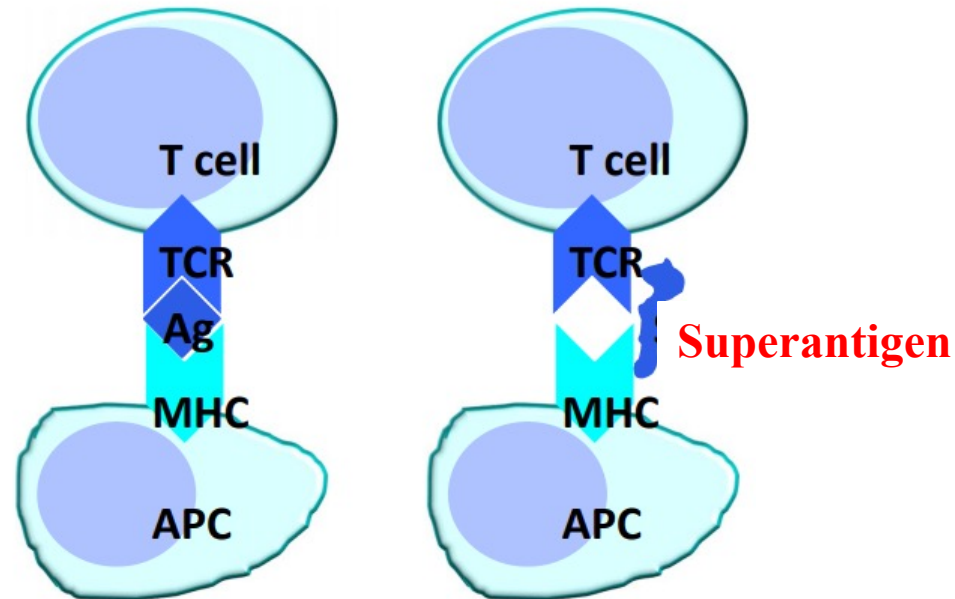
-Complete Freund's adjuvant

- The Freund's complete adjuvant is composed of inactivated and dried mycobacteria (usually *M. tuberculosis*), whereas
- The incomplete form lacks the mycobacterial components (hence just the water in oil emulsion).
- It is named after Jules T. Freund.

# Superantigens

Definition: Polyclonal T cell response

Examples *Staphylococcal* enterotoxins and Toxic shock toxin

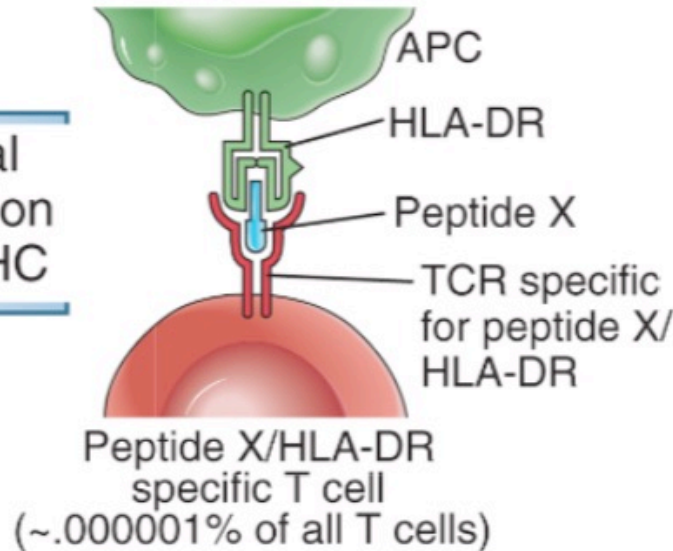




# Superantigens mechanism

A

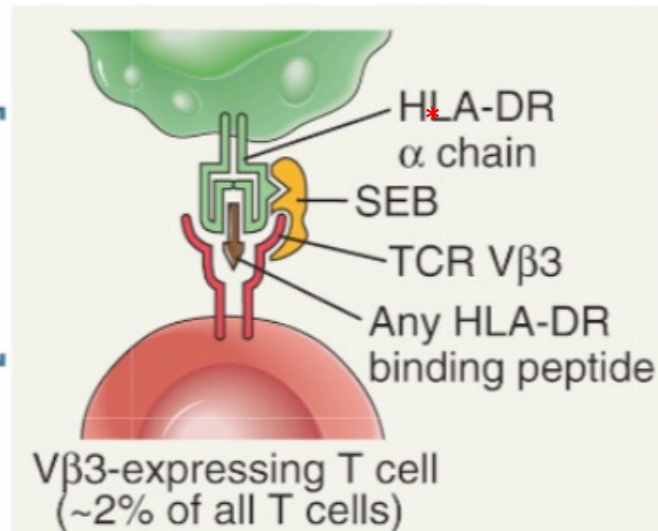
Conventional  
TCR recognition  
of peptide-MHC



**Activation of  
peptide X specific  
T cell clones only:  
protective immunity**

B

Superantigen  
binding to  
Class II MHC  
and TCR V $\beta$ 3



**Polyclonal activation  
of V $\beta$ 3<sup>+</sup> T cells:  
cytokine storm and  
deletion of T cells**

**\*SEB:  
Staphylococcus  
enterotoxin B**