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Antigen-antibody Reactions: An Overview

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Introduction

Antigen-antibody responses are the interactions between antigens and antibodies. Antigens react only with antibodies produced by themselves or closely related antigens in highly specific responses. Antibodies identify antigens' molecular structures (epitopes). In general, the closer the epitope fits to the antibody combining site (in terms of geometry and chemical character), the more favourable the interactions between the antibody and antigen will be, and the higher the antibody's affinity for antigen. One of the most critical elements in determining antibody effectiveness in vivo is antibody affinity for the antigen.

Description

Antigens and antibodies bind to each other in a specific way. Antigen-antibody reaction is the name for the interaction between them. Ag - Ab reaction is a common abbreviation for this reaction:

- These are the building blocks of humoral or antibody-mediated immunity.
- These reactions are used to detect infectious disease-causing agents as well as non-specific Ags such as enzymes.
- Serological reactions are Ag - Ab reactions that happen in the lab.
- There are three stages to the reactions between Ag and Ab.
- The reaction begins with the creation of an Ag-Ab complex in the first stage.
- The second stage results in visible phenomena such as precipitation, agglutination, and so on.
- The final stage entails the destruction or neutralisation of Ag.

Antigen-antibody reaction characteristics

- Antigen-antibody reaction specificity
- Immune complex
- The site of binding

Antigen-antibody reaction specificity refers to an individual antibody combining site's ability to react with only one antigenic determinant or a population of antibody molecules' ability to react with only one antigen. Each antibody binds to a specific antigen, analogous to a lock and key connection. An antibody raised against lens antigen, for example, will only react with lens antigen. In the same way, an antibody raised against kidney antigen will only react with kidney antigen. Only one antibody can react with its own antigen, so a conventional lock can only be opened by its own key.

Immune system

The integral binding of an antibody to a soluble antigen results in the formation of an immunological complex.

- A solitary immune complex is made up of a bound antigen that acts as a specific epitope and is bound to an antibody.
- Antigen-antibody interaction mechanisms that cause inflammation. Complement activation, opsonization of target cells, assembly of membrane assault complexes, and release of complement activators for chemotaxis all come from the development of antigen-antibody immune complexes.
- Cell activation mediated by Fc receptors causes phagocytosis, antibody-dependent cellular cytotoxicity (ADCC), and the release of inflammatory mediators.

$Ag + Ab \rightarrow Complex\ Ag - Ab$ Reaction of Antigen and Antibody

Antigen binding site - antibody reaction

- The antibody binds to the antigen in an antigen-antibody response.
- Epitope refers to the component of the antigen that interacts with the antibody.
- An epitope, also known as an antigenic determinant, is a portion of an antigen recognised by the immune system, specifically antibodies, B cells, and T cells.
- A paratope is the portion of an antibody that recognises the epitope.

Types of antigen - antibody reaction

Antigen-antibody reactions include the following:

- Precipitation reaction
- Agglutination reaction
- Complement fixation
- ELISA - Enzyme Linked Immuno Sorbent Assay
- Immunofluorescence

Chemical bonds responsible for the antigen-antibody reaction

In the same way that proteins connect to their cellular receptors or enzymes bind to their substrates, the interaction between the Ab-binding site and the epitope is entirely noncovalent. High ionic strength or severe pH can inhibit or disrupt the binding, making it UG 4thSem, Unit-IV reversible. In Ag–Ab binding, the following intermolecular forces are involved:

Electrostatic Bonds: This is owing to the attraction of two protein side chains with oppositely charged ionic groups, such as an ionised amino group (NH_4^+) on a lysine in the Ab and an ionised carboxyl group (COO_) on an aspartate residue in the Ag.

Hydrogen bonding: Hydrophilic groups (e.g., OH and C=O, NH and C=O, and NH and OH groups) can create relatively weak hydrogen bonds when the Ag and Ab are in close proximity.

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Hydrophobic interactions: Hydrophobic groups, such as the side chains of valine, leucine, and phenylalanine, tend to interact and consolidate in an aqueous environment due to Van der Waals bonding, excluding water molecules. As a result, the distance between them shrinks, increasing the attraction energy involved. This type of interaction is thought to account for up to half of the Ag–Ab bond's total strength.

Van der Waals bonds: The interactions between the "electron clouds" that surround the Ag and Ab molecules are responsible for these forces. The contact was compared to that which might occur between alternating dipoles in two molecules that alternate in such a way that oppositely orientated dipoles are present in closely apposed portions of the Ag and Ab molecules at any one time [1-5].

Types of Ag-Ab Reactions

1. Agglutination
2. Precipitation
3. Complement fixation
4. Enzyme linked immunosorbent assay
5. RadioImmuno assay
6. Western blotting

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