Antigen

Antigens (Ag) are substances that the immune system (IS) recognizes and responds to. Antigen means **foreign particles** (cells, soluble substances) and diversity in size and chemical composition. The most common antigens are foreign substances (**exoantigens**), often microorganisms and their products. Antigens from the body itself are called **endoantigens** (endogenous antigens). An **allergen** is an exoantigen that is able to cause a pathological (allergic) immune response in a susceptible individual.

Any chemical structure can act as Ag. Most often:

- proteins and glycoproteins,
- polysaccharides,
- nucleic acids,
- lipoproteins.

In order for IS to respond to antigen, they must be recognized in the form of macromolecules (soluble or present on the cell surface).

Basic features of antigen

Immunogenicity is the ability to induce, the ability to cause an immune response, a response. **Specific reactivity** means the ability to react only with a specifically relevant antibody (T-lymphocyte).

The optimal size of the antigen is 20-50 thousand units. Most antigens are **T-dependent**, ie. dependent on T-lymphocytes. A certain unrelated nature is required (the more unrelated, the more immunogenic). This is determined by the degree of antigen's foreignness:

- ***autologous*** - Ag comes from one's own organism, it does not cause the production of antibodies (it is not actually Ag);
- ***syngeneic*** - from individuals of the same genetic make-up (identical twins, clones, inbred lines);
- ***allogeneic*** - an individual of the same species;
- ***xenogeneic*** - an individual from another species; the highest degree of unrelatedness.

Epitope

The whole antigen molecule does not participate in the actual reaction of the antigen with the antibody, but only some of its surface groups, the so-called **determinant groups** or **epitopes**. One molecule can carry different amounts of epitopes (one to several thousand) on its surface. Antigens are often also **bound** , eg to the membrane of microorganisms. **Structural rigidity** (fixed position of determinant groups) is also important for antigenicity . The *higher it is, the* more **pronounced** the antigenic properties. Therefore, denaturation reduces antigenicity in most cases. However, this does not apply without exception, because sometimes denaturation reveals hitherto hidden epitopes. Also, possible exposure of tyrosine groups will increase antigenicity.

Haptens

They are low molecular weight substances with their own **epitopes**. They themselves lack immunogenic properties. However, this changes when attached to a **macromolecule** (the common molecular weight (Mr) must be at least above 10,000). Such **incomplete antigens** are called **haptens** (from the German *Halbantigen*). They are used specifically for the **determination of various substances** in immunological methods.Jsou to nízkomolekulární látky s vlastními **epitopy**. Samy imunogenní vlastnosti postrádají. To se však mění, naváží-li se na **makromolekulu** (společná molekulová hmotnost (Mr) musí dosahovat alespoň hodnoty nad 10 000). Takové **neplnohodnotné antigeny** nazýváme **hapteny** (z německého *Halbantigen*). Bývají cíleně užívány pro **stanovování nejrůznějších látek** při imunologických metodách.

Superantigen

A superantigen is an *exoantigen*, usually a product of infectious microorganisms, that induces **non-specific** activation of a large number of lymphocytes regardless of their antigenic specificity; microbial substances causing inflammation activate the system non-specifically (*atopic eczema*). They do not require processing by antigen-presenting cells to activate the immune system .

These are microbial products with **two binding sites**:

- one binds to an epitope present on all HLA II molecules. class (β2-domain);
- the latter bind to structures shared by many different **TCR** molecules (V region of the β-domain).

They bind to the T-cell receptor at another site (slightly non-specifically) and thus also stimulate it. This leads to stimulation of a number of T-clones (non-specific polyclonal T-cell activation) and pathological activation of inflammation. **Superantigens** give a signal leading to rapid T-cell activation, secretion of a number of cytokines. They can also cause shock conditions. Some superantigens are membrane proteins anchored on the surface of APCs (products of some oncogenic retroviruses), others are soluble toxic products (eg staphylococci).

Consequences of superantigen action

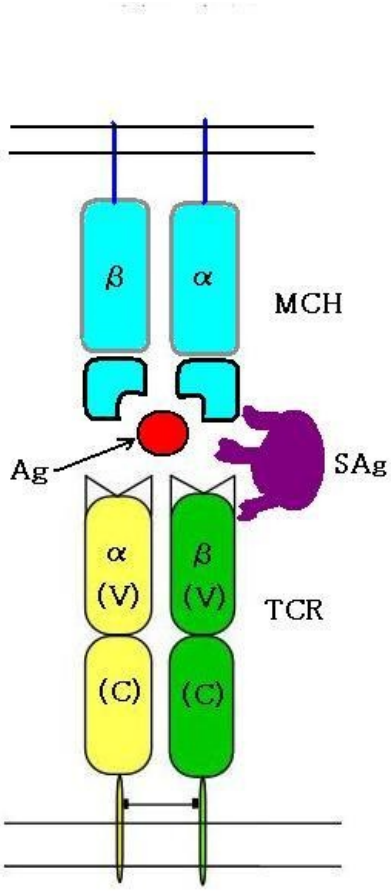
- **Immunomodulatory effect** - after binding, they **induce an overall defense response**, activating a huge number of cells regardless of antigen specificity.
- Polyclonal activation, cytotoxic activity, increased amount of CD4, CD8, B-lymphocytes, macrophages, NK cells, cytokine release.
- Production of large amounts of **cytotoxins , death of many immune cells**, unnecessary production of non-protective **autoimmune antibodies**.
- Apparently responsible for the development of some **autoimmune diseases**.
- They increase susceptibility to endotoxin (risk of simultaneous infection with G− bacteria).

Soluble superantigens

- **toxic shock syndrome enterotoxin and toxin** of *S. aureus*;
- pyrogenic toxins of *Str. pyogenes*;
- superantigens of mycoplasma, pseudomonads;
- enterotoxin of *Clostridium perfringens*.

Cell-bound superantigens

- **M protein** of *Str. pyogenes*;
- *Mycobacterium tuberculosis* component;
- *Yersinia enterocolitica*.



Superantigen (SAg) combining TCR and HLA II

Sequestered antigen

Sequestered antigens are not physiologically in contact with IS cells. In the body, it is located in a localization isolated from the action of leukocytes, antibodies and complement (isolated from the bloodstream, tissue fluid, lymph). In the event that a meeting occurs in the future, the organism perceives it as **foreign**, even though it is **its own** . Examples include the lens of the eye, Ag from sperm, from the CNS. They are detected and reacted to in the event of a trauma. Therefore, **reactions of an autoimmune nature** sometimes develop .

Immunocomplexes

Complexes of antigen with antibodies and with complement fragments are called **immunocomplexes**. They physiologically induce phagocytosis and are eliminated. In pathological conditions, they are stored in tissues or activated by **leukocytes**. They participate in immunopathological reactions.

Adjuvant

The **adjuvant** helps in the uptake of antigen by antigen-presenting cells, or helps in non-specific stimulation of immunity. It is used in animal immunization, in humans to stimulate specific IS (when co-administered with specific Ag; increases non-specific immunity). The response is stronger, more intense, the antibodies last longer and there are more of them. It can form a kind of subcutaneous depot from which Ag is gradually released.

- **Freund's adjuvant** (experimental) - oil, water, killed mycobacteria.
- **Aluminum hydroxide** (in medicine) - Ag is adsorbed on its small particles, then they are well absorbed by APCs, it induces especially auxiliary T-lymphocytes.

Links

Related articles

- Antibodies
- Specific immunity
- Innate immunity
- Allergy

External links

- Antigen (Czech wikipedia) (https://cs.wikipedia.org/wiki/Antigen)
- Antigen (English wikipedia) (https://en.wikipedia.org/wiki/Antigen)

References

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