LESSON8

Immune deficiencies. Autoimmune diseases. Hypersensitivity reactions. Principles of immune prophylaxis and immunotherapy. Vaccines and immune serums

Immunoprophylaxis and Immunotherapy

- Measures for immunoprophylaxis and immunotherapy are aimed at creating active or passive immunity to pathogens of infectious diseases and are used to prevent the development of these diseases.
- The induction of active or passive immunity in the body develops as a result of immunization carried out to protect against infectious diseases.

Vaccines

- Vaccines - immunobiological preparations intended for active immunoprophylaxis, that is, to create an active specific immunity of the body
- Vaccines are a complex immunobiological preparation, which, along with a specific antigen, based on the nature and dosage form of the preparation, include stabilizers, preservatives, adjuvants.

Inactivated vaccines (killed)

- Inactivated (killed) vaccines include killed cultures of pathogenic bacteria or viruses (whole cell, whole virion vaccines) or complexes extracted from pathogenic microbes (sometimes vaccine strains) containing protective antigens (subcellular, subvirion vaccines).
- For inactivation, formaldehyde, alcohol, phenol, temperature exposure, UV irradiation, ionizing radiation are used. Trichloroacetic acid, phenol, enzymes, isoelectric precipitation, ultracentrifugation, ultrafiltration, chromatography, and other methods are used to isolate antigenic complexes.

Live (virulence-attenuated, attenuated) vaccines

- Live vaccines are preparations in which the active principle is weakened strains of pathogenic microbes (bacteria, viruses) that have lost their virulence, called attenuated strains.
- As live vaccines, divergent strains can be used, i.e., microbes that are not pathogenic for humans and have common protective antigens with pathogens that are pathogenic for humans. Divergent vaccines include BCG vaccine, rabies vaccine, measles vaccine.
- Vector vaccines are live vaccines. obtained by genetic engineering - they contain recombinant strains that are non-pathogenic for humans, carrying the genes of protective antigens of pathogenic microbes and capable of multiplying when introduced into the human body, synthesizing a specific antigen and, thus, creating immunity to the pathogen. Vaccinia virus, non-pathogenic strains of Salmonella and other microbes are more often used as vectors.

Obtaining vector vaccines

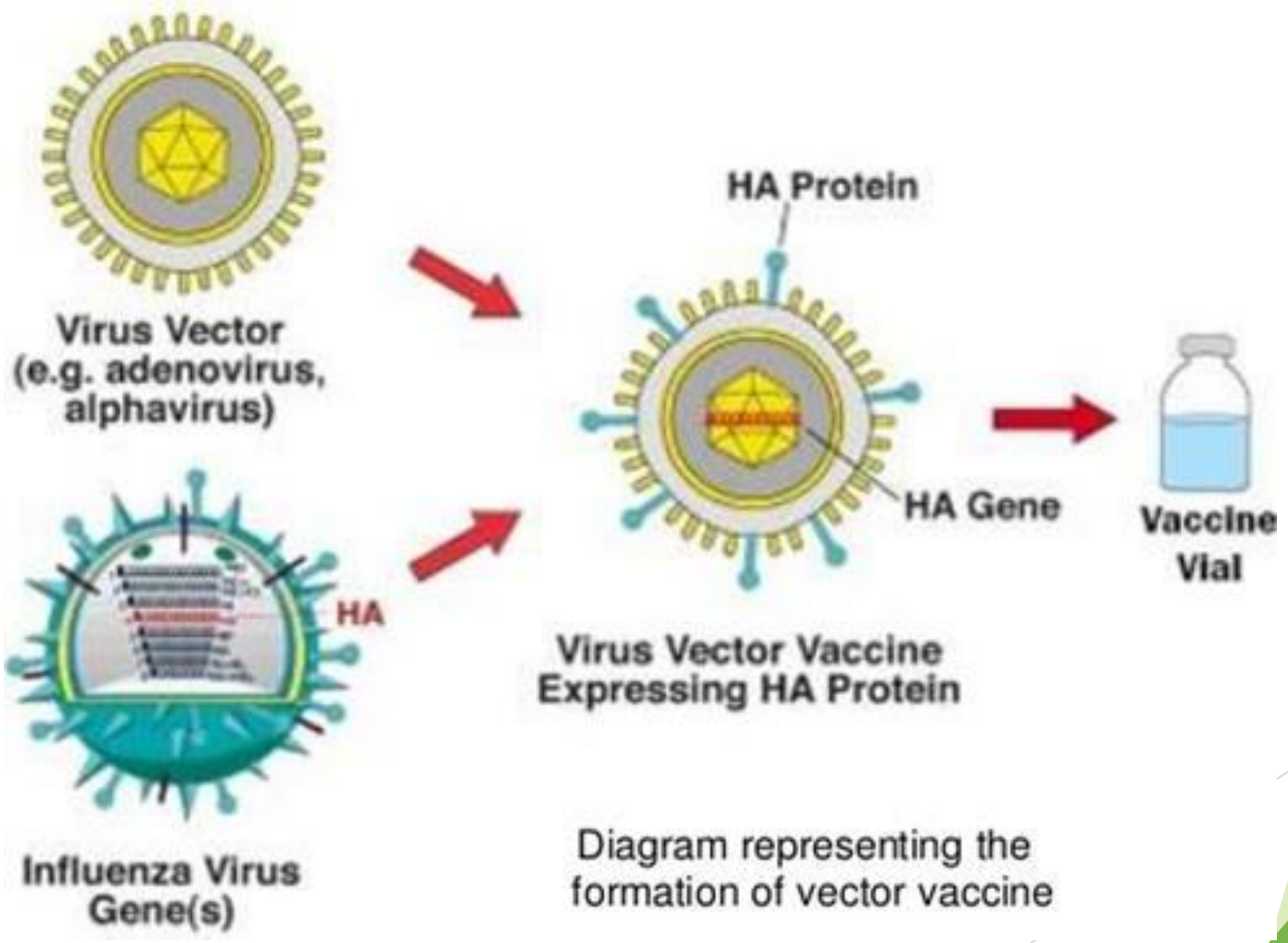
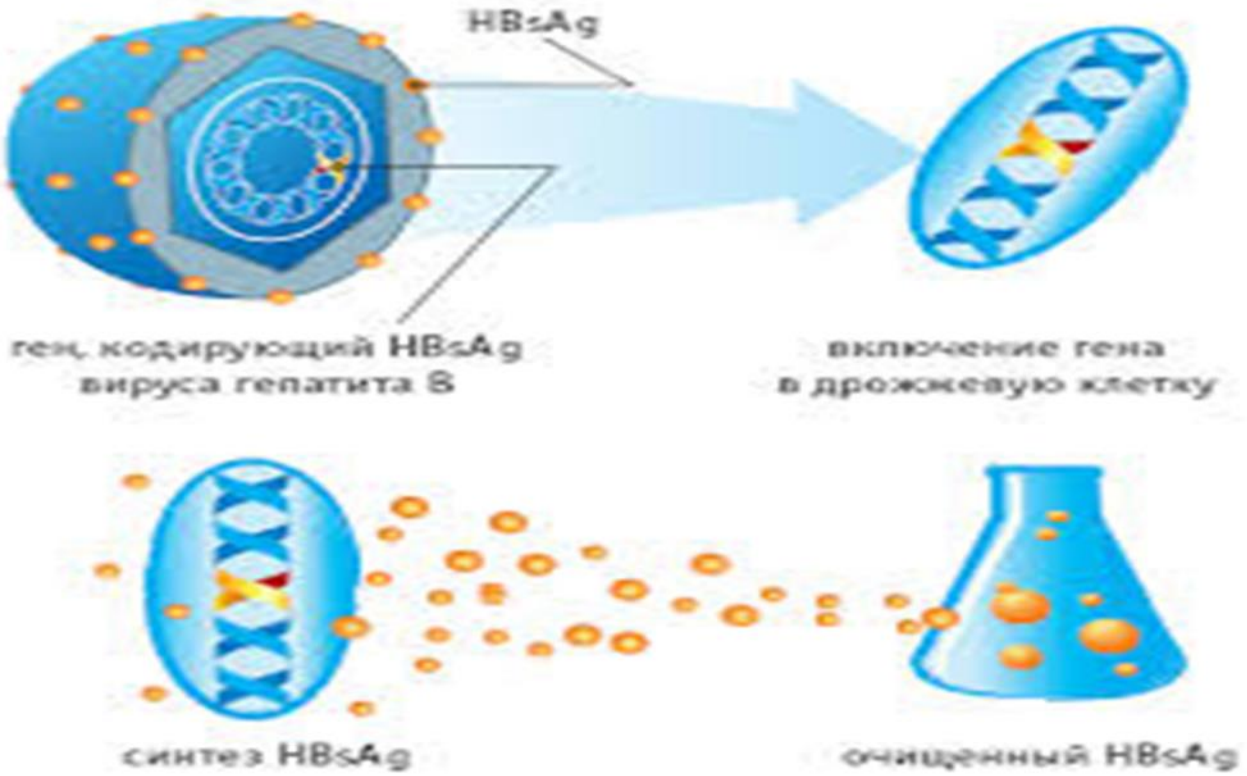


Diagram representing the formation of vector vaccine

Chemical vaccines

- The development of genetic engineering, the creation of recombinant bacteria and viruses capable of synthesizing molecules of antigens unusual for them, have opened up the possibility of obtaining molecular antigens in the process of cultivating recombinant strains. Thus, antigens of HIV, viral hepatitis, malaria, measles, poliomyelitis, influenza, tularemia, brucellosis, syphilis and other pathogens can be obtained.
- In medical practice, a molecular vaccine against hepatitis B is already being used, obtained from a virus antigen produced by a recombinant yeast strain.

Scheme for the preparation of a recombinant vaccine containing HBs - antigen of hepatitis B virus



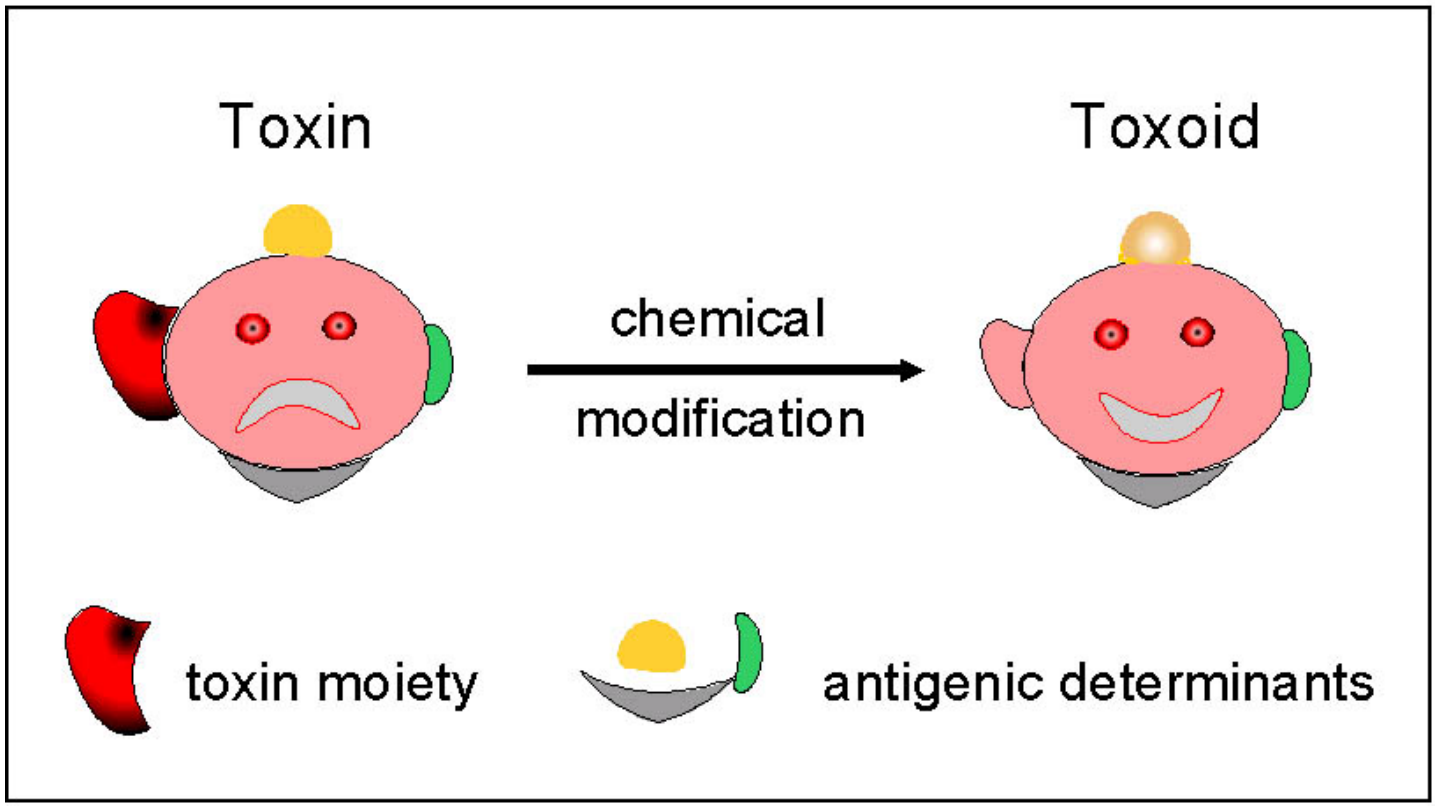
Synthetic vaccines

- Molecules of antigens or their epitopes in themselves have low immunogenicity, therefore, searches are underway to increase the immunogenicity of molecular antigens by artificially enlargement of their molecules due to the chemical or physico-chemical bond (crosslinking) of the antigen or its determinant with polymeric large-molecular carriers harmless to the body (such as polyvinylpyrrolidone and other polymers), which would play the role of "schlepper" and adjuvant.
- Thus, a complex is artificially created, consisting of: antigen or its determinant + polymer carrier + adjuvant. Thanks to this composition, antigens can be stored in the body for a long time and easier to adhere to immunocompetent cells. Vaccines created according to this principle are called synthetic. The problem of creating synthetic vaccines is quite complicated, but it is being actively developed.
- Thus, a vaccine against influenza has been created using a polyoxidonium polymer, as well as a number of other experimental vaccines.

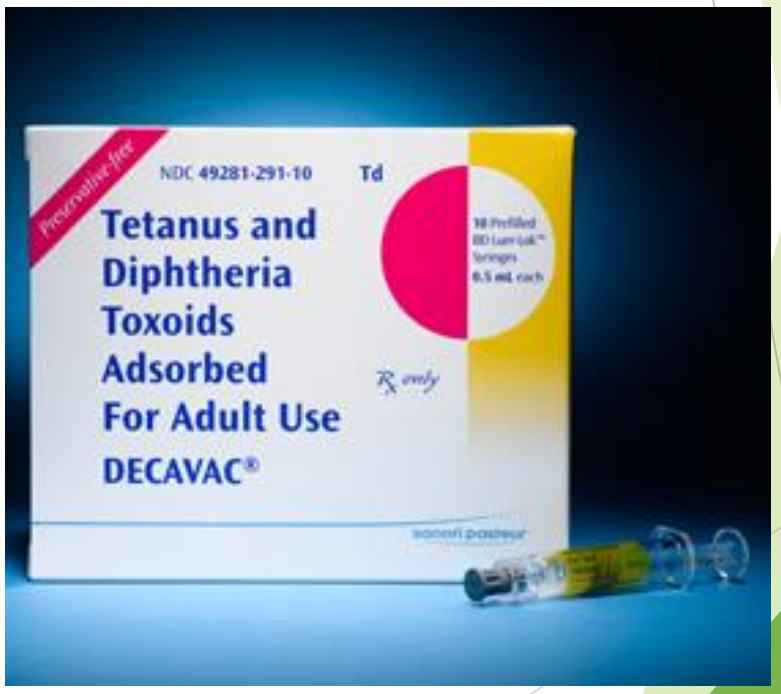
Toxoid or toxoid vaccines

- Anatoxins (toxoids) are an example of molecular vaccines: diphtheria, tetanus, botulinum, gangrenous (perfringens, novi, etc.), staphylococcal, cholera toxoids.
- Toxoids are obtained by exposure to 0.4% formaldehyde and heat (37°C) for 3-4 weeks. to the toxin, converting it into a non-toxic, but retaining specific antigenic form. Adjuvants are added to the purified and concentrated toxoid to increase its immunogenicity, usually sorbents - Al(OH)3 and Al(PO4) gels.

Toxoid or toxoid vaccines



Most commonly used toxoid vaccines



Adjuvants

- To enhance the immunogenicity of vaccines, adjuvants are used (from Latin adjuvant - assistant). Most adjuvants are substances foreign to the body, have a different chemical composition and origin; their similarity lies in the fact that all of them are able to enhance the immunogenicity of the antigen.
- The action of adjuvants is reduced to enlargement of the antigen molecule (sorption, chemical bonding with a polymer carrier), as a result, the antigen is better captured and more actively presented by phagocytic and other immunocompetent cells.
- In addition, adjuvants cause an inflammatory reaction at the injection site with the formation of a fibrous capsule, as a result of which the antigen is deposited at the injection site and, coming from the depot, acts for a long time according to the principle of summation of antigenic irritations (revaccinating effect).

Most commonly used adjuvants

- The following are used as adjuvants: inorganic (aluminum and calcium phosphates, calcium chloride, etc.) and organic (agar, glycerol, protamines, etc.) substances.
- Currently the most widely used:
- Incomplete Freund's adjuvant - is a water-fatty emulsion containing vaseline oil, lanolin and an emulsifier. Deposits the antigen and enhances its uptake by phagocytes.
- Complete Freund's adjuvant - includes, in addition to the above components, BCG or muramyl dipeptide. This allows it to further activate macrophages and co-stimulate T cells.
- Aluminum alum Al OH3 (aluminum hydroxide), which, due to its high sorption capacity, performs the function of an antigenic depot, and also non-specifically enhances phagocytosis.

Immunoprophylaxis or vaccination

- It is carried out in accordance with the planned and epidemiological guidelines.
- In each country there is a calendar of preventive vaccinations and control over the implementation of vaccinations.
- Mandatory conduct of such vaccinations is regulated by law.

Immune sera

- Serum immune preparations include immune sera and immunoglobulins. These drugs provide passive immunity to pathogens of infectious diseases.
- The mechanism of action of immune preparations is reduced to the neutralization of the corresponding microorganisms or their toxins by the antibodies that are part of these preparations.

Immune sera used for immunoprophylaxis and immunotherapy

- On the basis of antibodies, many immunobiological preparations have been created that are used for prevention (seroprophylaxis) and therapy (serotherapy)
- Immune sera are obtained by hyperimmunization (i.e., multiple intensive immunization) of animals (horses, donkeys, sometimes rabbits) with a specific antigen, followed, during the period of maximum antibody production, bloodletting and isolation of immune serum from the blood.
- Immune sera obtained from animals are called heterogeneous, since they contain serum proteins foreign to humans.
- To obtain homologous immune sera, the sera of recovered people or specially immunized human donors are used. or serum from placental, as well as abortion blood, containing antibodies to a number of pathogens of infectious diseases due to vaccination or past disease

The use of immune sera

- Especially effective is the use of serum preparations for the treatment of toxin infections (tetanus, botulism, diphtheria, gas gangrene), as well as for the treatment of bacterial and viral infections (measles, rubella, plague, anthrax, etc.) in combination with other methods of treatment.
- For therapeutic purposes, serum preparations are administered as early as possible intramuscularly (sometimes intravenously) in large doses.
- Preventive doses of serum preparations are much less than therapeutic ones, and the preparations are usually administered intramuscularly to persons who have had contact with a sick person or other source of infection to create passive immunity. With the introduction of serum preparations, immunity occurs after a few hours and persists for several weeks.

Diagnostic immune sera

- Diagnostic immune sera are used to identify microorganisms in serological tests.
- These sera are obtained by hyperimmunization of laboratory animals (mainly rabbits) with cultures of microorganisms or their antigens.
- The most commonly used diagnostic serum of rabbits, because it contains high titers of specific antibodies.