Kazakh National Medical University named after S.D. Asfendiayrov

Department of Microbiology, Virology and Immunology

The specialty: Stomatology

Lecture 2: Infection. Forms of infection. Immunity. Types and forms of umminity. Factors specific and nonspecific defense. Serological reaction. Antigens. Antibodies. The Basic principles of immunization and immunotherapy

Infection (infectious process) - a set of physiological and pathological processes, emerging and developing in the body when introducing him pathogens that cause a violation of the constancy of its internal environment and physiological responses (Timakov).

- invasion of a host organism by microorganism, proliferation of the invading organism, and host reaction

For the development of the infectious process must be 3 factors:

1. The pathogenic microbe
2. The susceptible microorganism
3. Certain environmental conditions

Infectious diseases - is the extreme manifestation of infection.

It is distinguished from other diseases::

1. The presence of a pathogenic microbe
2. The contagiousness
3. Cyclicality (proceeds periods)
4. Specific reactions of the organism to the pathogen
5. Development of immunity
6. Bacteria carriage

Pathogens - is the potential ability to cause disease (species characteristic).

VIRULENCE of microbes - is the degree of pathogenicity (the strain sign).

Pathogenicity factors of microbes:

- Adhesion
- COLONIZATION – presence of microorganisms on skin or mucosa, no penetration into tissues.
- Invasions - the penetration and proliferation associated with the introduction of live tissue (due to the enzyme hyaluronidase, neuraminidase, plasma coagulase)
- Suppression of phagocytosis (by capsule, M protein from streptococcal protein A from Staphylococcus, cord factor in the tubercle bacillus)
- AGRESSINS - substances that suppress the body's defenses and enhancing pathogens
- Toxin - a poisonous substance produced by pathogenic microbes. Divided into exo-and endotoxins.

Exotoxins - labile proteins secreted by microbes in the environment, are highly toxic. Characterized Organotropona, virulence, antigenicity, immunogenicity.

By the mechanism of action are divided into :

- Neurotoxins (tetanus)

- Histo toxins (diphtheria)

- Enterotoxins (cholera)

- Hemolysin (lysis of red blood cells - strep)

-leycocidins (staph)

Can be transformed into anatoxin - exotoxin is deprived of toxicity, but has antigenic and immunogenic properties. It is used to prevent infections.

Endotoxins - thermostable lipopolysaccharide (LPS), a part of the cell wall, gram (-) are detection of the destruction of bacteria. They do not have specificity. The antigenicity and immunogenicity is the weak. The cause of cardiac depression and low body temperature.

The degrees of pathogenicity of a microbe - VIRULENCE denoted:

- ***Dlm - dosis letalis minima - min. mortality. dose - the smallest number of living microbes, causing the death of 80% -95% of the animals***
- ***Dlc - dosis letalis certa - certainly lethal dose - from which killed 100% of infected animals.***
- ***LD50 - dose of dies which 50% of infected animals***
- ***DI - dosis infectionis - infective dose (the minimum number of microbial cells that can cause infectious process).***

For origin and development of infectious disease are essential:

- The infectious dose of pathogens (the minimum number of microbial cells capable of causing infectious process)
- Portal of entry - the body's tissues through which the organism enters the macro-organism.

- Source of infection:

Soil

Air

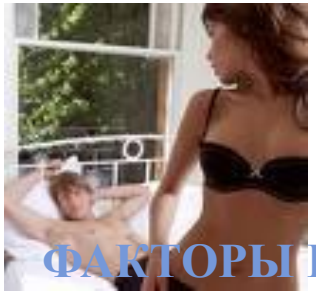
Food

household objects

Bacteria carriager

Transmission

Парантеральный



•Genital

ФАКТОРЫ ПЕРЕДАЧИ:

•Transmissive

•Fecal-oral

•By Contact

•Airborne

transplacental

Factors of transmission

PERIODS OF INFECTION

- Incubation - from infection to the first signs of the disease (not contagious)
- Prodromal - nonspecific common manifestations (can be dangerous)
- Height - the period of the development of clinical symptoms
- Outcome:
  - recovery
  - death
  - bacteriocarrier

CLASSIFICATION OF INFECTIONS

BY THE CAUSATIVE AGENT

bacterial
viral
fungal
protozoal

BY PRESENT CLINICAL SYMPTOMS

typical
atypical

BY LOCATION

total (generalized)
local (alopecia)

BY DURATION:

- acute
- chronic
- persistent (long-term experience and microbial growth within the cells, such as macrophages)
- bacteriocarrier

DEGREE IN CLINICAL EXPRESSION:

- symptomatic (symptomatic)
- abortive
- latent

BY DESCENT:

- exogenous
- endogenous
- autoinfection

source of infection:

- anthroponoses (of people) – Gonorrhea
- Zoonoses (of animals) - brucelosis
- anthropozoonoses (of people and animals) – plague
- Sapronoses (dead matter) - Legionella pneumophila

BY INTENSITY DISTRIBUTION:

Sporadic – isolated occurrence with no apparent connections between localities or times of occurrence

- Group - a small number of cases in one community
- Epidemic – significantly increased occurrence within a given localities and time periods
- Pandemic - significantly increased occurrence within a given localities and time periods without restriction
- The number of species of agent:
- monoinfection (1 microbe)
- mixed infections (mixed) - tank + virus

ON the spread of germs and toxins:

- bacteremia - bacteria circulating in the blood
- viremia - the virus circulates in the blood
- toxinemia (exotokisn) and toxemia (endo)
- septicemia - microbes multiply in the blood
- pyosepticemia - microbes multiply in the blood, are carried to the organs and tissues, there form secondary purulent foci.
- sepsis (proliferation of microbes in the blood)

Reccurent infection:

- secondary - to the existing inf-ii + new Notices
- reinfection - sick with the same disease after complete recovery
- superinfection - the patient during the illness are infected by the same pathogen
- relapse - a return wedge. manifestations due to microbial residues after the first infection

Pathogenicy factors

- ***Hyaluronidase*** **- cleaves hyaluronic acid intercellular substance increases the permeability of the mucous membranes and conjunctive tissues**
- ***Neuraminidase*** **–penetrates inside the cell are distributed in the intercellular space.**
- ***Coagulase*** **(thicken blood plasma)**
- ***Plasmin*** **(dissolves fibrin clots)**
- ***Leukocidin*** **(destroys white blood cells)**
- ***Lecithinase*** **destroys cell membranes**

Particular viral infections

1. Obligate parasitism of the virus, its pathogenicity of infectious its NC - "infectivity"
2. The high specificity, Organotropona (there are neurotropic viruses, hepatotropic viruses)
3. Blood viruses - transport environment, the presence of viremia stage.
4. Interaction of the viral genome and the genome of the cell
5. Infectious viruses - self-reproduce its genotype
6. Integration viruses - viral genes integrated into the chromosome of the cell and cause degeneration of cells (oncoviruses)
7. virus in immune system cells (lymphocytes) -virus influenza, measles, herpes, polio, AIDS, etc. Lymphotropic reflected in the outcome of the pathogenesis and viral infections (immunodeficiency)
8. The formation of intranuclear and intracytoplasmic inclusions - smallpox, rabies, herpes, measles, etc. Have diagnostic value

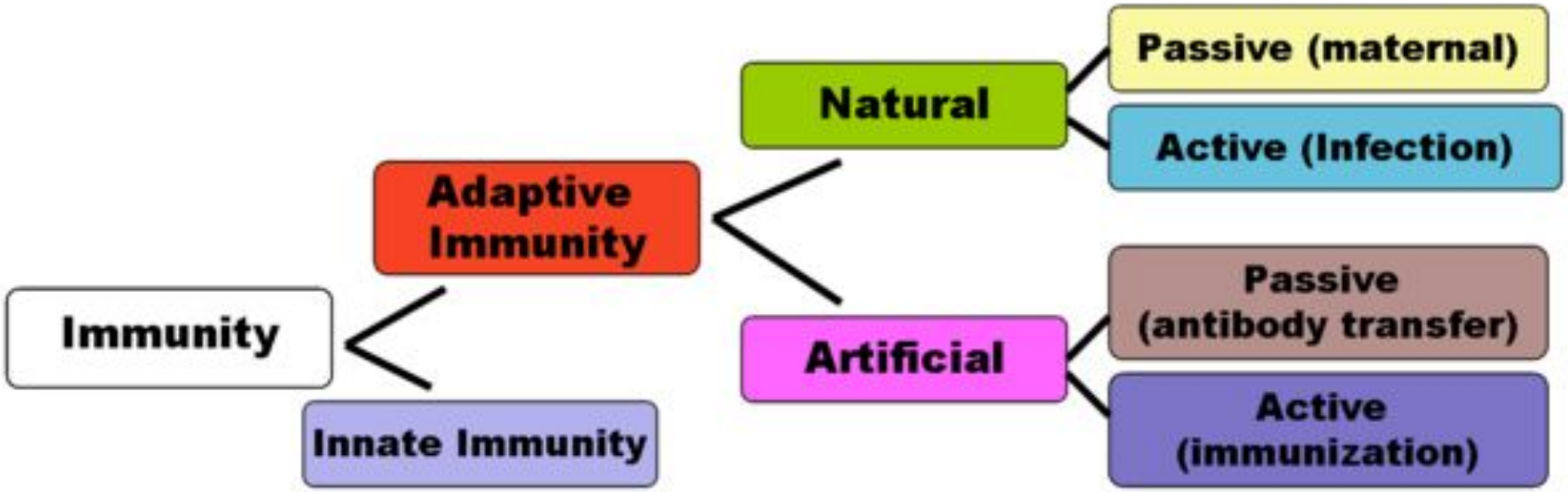
FORMS OF VIRAL INFECTION

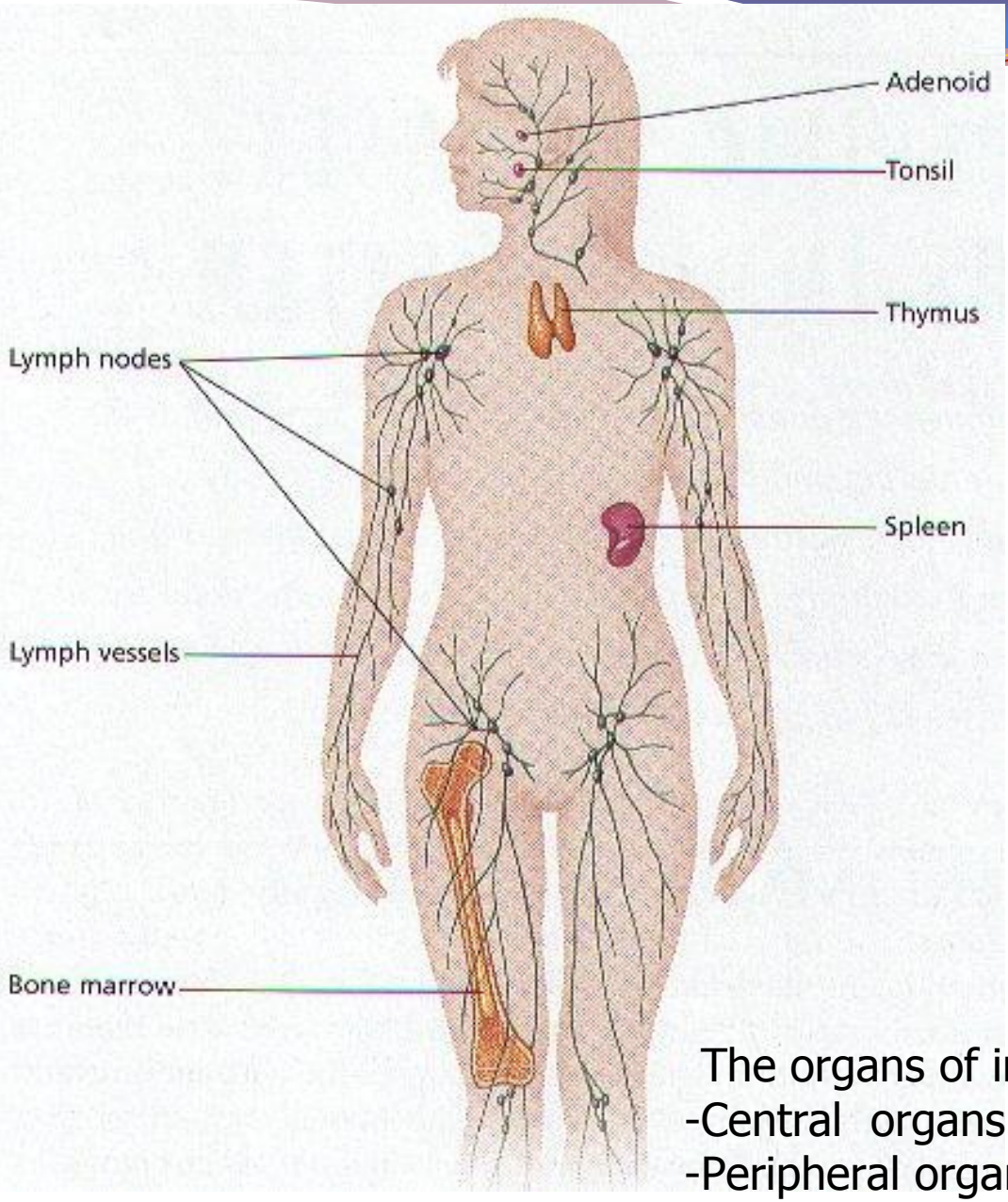
- Productive - acute, accompanied by a reproduction of the virus in the cell and their rapid release:
- focal
- generalized
- persistent
- The latent (asymptomatic) - the lack of virus isolation
- Chronic -vydelenie virus from the body
- Abortive - suspension of production
- The development of neoplastic degeneration of cells (oncogenic viral infection)

Immunity

What is immunity?

- It is the capability of the body to resist harmful microorganisms or viruses from entering it.
- The immune system produces antibodies or cells that can deactivate pathogens.
- Fungi, protozoans, bacteria, and viruses are all potential pathogens.


Immunity
Innate Immunity
Adaptive Immunity
Natural
Passive (maternal)
Active (Infection)
Artificial
Passive (antibody transfer)
Active (immunization)



The organs of immunity system:
-Central organs
-Peripheral organs

I Innate immunity

II Adaptive immunity

1. ***Natural***

sterile (after the establishment of the immunity germs are eliminated from the body) and non-sterile (produced in the presence of germs)

a) an antimicrobial

b) antitoxic

c) antiviral

g) Antifungal

Natural passive (placental)

Artificial active (post-vaccination) - formed in a few weeks and lasts for several years

Artificial passive (postserum) - formed after a few hours and lasts for several weeks or months

- Cellular immunity - this is the function of T-lymphocytes. T-killer cells destroy antigens by direct cytotoxicity and by the synthesis of lymphokines.
- The regulation of the immune response involves two subtypes of T cells: T helper enhance the immune response of T-suppressors have the opposite effect.

- Humoral immunity - this is the function of B cells.
- T helper → B LM → clone antibody-producing cells (plasma cells) immunoglobulins (antibodies) (Ig) →
- → AH AT complex.

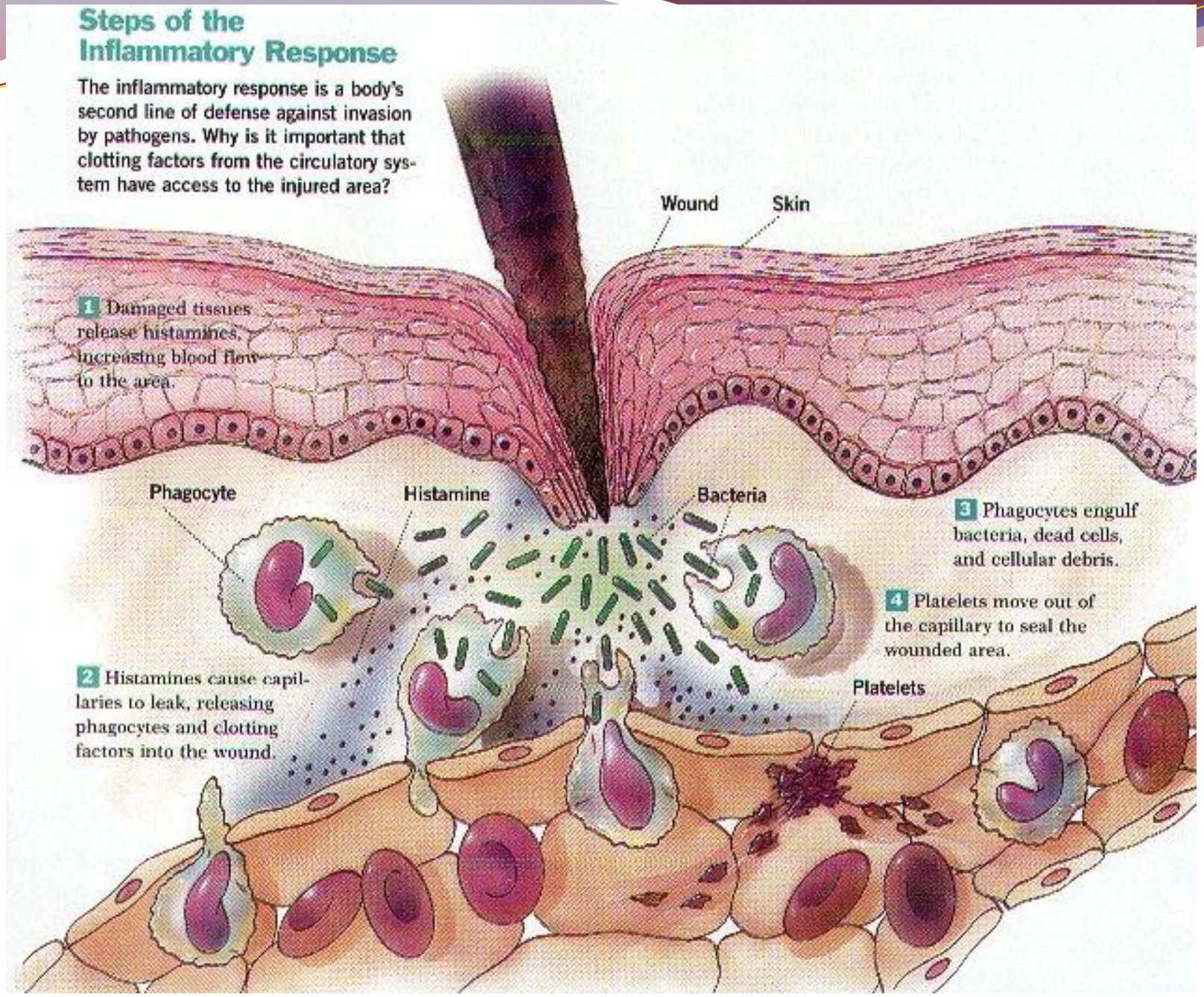
- Initial immune response occurs when you first meeting with an antigen. His expression reaches a maximum of 7 - 8 th day, persists for 2 weeks, and then decreases; (Ig M)
- secondary immune response occurs at the second meeting with the antigen by the cells of immunological memory. The secondary immune response is developing rapidly due to the memory cells and reaches more (3 - 4 times) intensity;(Ig G)

The immune response to all types of passes 2 Phases :

- 1st, nonproductive - antigen recognition and interaction of immune cells;
- 2nd, productivity - the proliferation of effector cells and antibody production.

- ***First-Line Defenses /Innate Immune System-*** The body's first line of defense against pathogens uses mostly physical and chemical barriers such as
- Skin – acts as a barrier to invasion
- Sweat – has chemicals which can kill different pathogens.
- Tears - have lysozyme which has powerful digestive abilities that render antigens harmless.
- Saliva – also has lysozyme.
- Mucus - can trap pathogens, which are then sneezed, coughed, washed away, or destroyed by chemicals.
- Stomach Acid – destroys pathogens

- ***Inflammatory response*** causes
- Redness - due to capillary dilation resulting in increased blood flow
- Heat - due to capillary dilation resulting in increased blood flow
- Swelling – due to passage of plasma from the blood stream into the damaged tissue
- Pain – due mainly to tissue destruction and, to a lesser extent, swelling.


Steps of the Inflammatory Response
The inflammatory response is a body's second line of defense against invasion by pathogens. Why is it important that clotting factors from the circulatory system have access to the injured area?
Wound
Skin
1 Damaged tissues release histamines, increasing blood flow to the area.
Phagocyte
Histamine
Bacteria
3 Phagocytes engulf bacteria, dead cells, and cellular debris.
4 Platelets move out of the capillary to seal the wounded area.
2 Histamines cause capillaries to leak, releasing phagocytes and clotting factors into the wound.
Platelets

Skin and mucosa

- *The barrier function*
- *The bactericidal properties*
- *Mechanical protection*

Normal microflora

- *Mechanical protection*
- *Antagonism*
- *It promotes the maturation of the immune system*

Phagocytosis

The functions of phagocytes:

Protective

representing

Secretory (IL-1)

Stages of phagocytosis:

chemotaxis

Adhesion

endocytosis

Education phagolysosome

Intracellular digestion

NK cells (natural killer cells)

lymfocit-shared population of cells possessing the natural cytotoxicity

Antiviral

Antitumor

Antiprotozoal

humoral factors

Lysozyme - thermo-stable protein (muramidase). Produced by monocytes and tissue macrophages. The marked effect on the Gram+ bacteria

The complement system -20 regulatory serum proteins

Pathway:

1. Classic Ag+ AT → C1, C4, C2 → C3

2. Alternative LPS properdin, Mg 2+ → C3

Cytokines - **hormone-like mediators (interleukins, interferons, growth factors), produced by various cells of the body and can affect the function of other or the same group of cells**

THE IMMUNE SYSTEM

The hierarchical unity of organs and cells that function as a single unit, protecting the body against infections and foreign agents

Features of the immune system:

- **The cells are spread throughout the body**
- **The cells are circulating in the blood**
- **Constantly develops AT**
- **It consists of 1012 lymphoid cells**
- **The total weight of 1.5-2 kg**
- **The central figure - lymphocyte**

The Cells of Immunity System

Immunocompetent - capable of specific immune responses, which have receptors AG

Auxiliary - (antigen) - the ability to distinguish foreign cells from their own and submit them to immunocompetent cells.

Cells AG-nonspecific defense that distinguish the body's own components from foreign particles and destroy them

lymphocytes

LM T - **cell immune response**
LM B - **the humoral immune response**
T LM **(80% lymphocytes)**
T - effectors
T - killers
T - helpers
T – suppressor

Features:

- **cell-mediated immunity;**
- **regulation of the activity of B-cells (immunologic memory and tolerance);**
- **hypersensitivity (IV) type.**
- **graft rejection;**
- **antitumor immunity**

B- ЛМ *(20 % of lymphocytes in blood)*

Features:

1. AT Products

2. Participants in the antigen presentation of T lymphocytes

Antigens - **substances of any origin, can cause the body's specific immune response and to participate in its implementation**

Properties:

- **Alien**
- **The antigenicity**
- **Specificity**
- **Immunogenicity**
- **Protein nature**
- **High MR**
- **Types AG**

Full - **capable of inducing the formation of specific antibodies and to react with them**

Haptens - **failed to induce the formation of specific antibodies and to react with them**

The structure of the AG 2 components:

- **Protein - defines the antigenicity**
- **The amino acid residues (determinant group) located on the surface of the protein - specificity.**

Types of Antigens

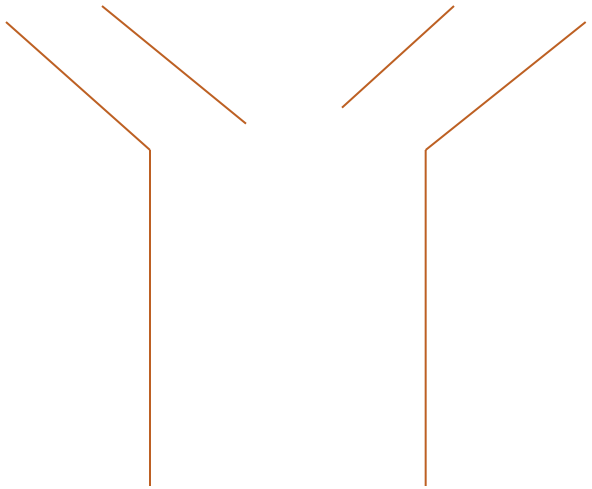
Geteroantigens- common Antigens, found in representatives of different types of microorganisms, animals and plants. For example, Antigens Forsman - guinea pig, e / c sheep and Salmonella.

- ***Cross-react AG (PRA)*** **- found in a number of micro-organisms and in human tissues. For example, hypertension hemolytic streptococcus, the human myocardium and renal glomerulus, so provokes rheumatic heart disease and glomerulonephritis.**
- ***Izoantigens*** **- some of them individuals or groups of individuals differ (ABO blood)**
- ***Tumor*** **- as a result of malignant transformation**
- ***Viral*** **- linked to the nucleocapsid or envelope glycoproteins**
- ***HLA*** **-** ***Antigens*** **major histocompatibility complex**
- ***Somatic*** **-** ***thermostable O Antigens***
- ***The flagellar*** **-** ***labile H Antigens***
- ***Capsule*** **-** ***labile K - Antigens***
- ***Antigens virulence*** **-** ***Vi - Antigens***
- ***Autoantigens*** ***(glass. Body, the thyroid gland)***

- **Immunological tolerance - the body does not respond to the AG and does not produce antibodies. Occurs when the body met with antigens in the embryonic period, when the defects of the lymphoid tissue, when very high or very low doses of antigen in an organism with a weak Immunity system.**
- **Immunological paralysis - the inability organism produce AT form when very high doses of antigen. Due to blockade of immunocompetent cells. After removing unnecessary AG products AT resumes.**
- **Immunodeficiency - reduction or absence of humoral and cellular defense. congenital and acquired.**

- An **antibody** is a protein produced in response to an antigen.

Structure of Antibodies



types of immunoglobulins

5 types of immunoglobulins:

1. Ig G
2. Ig M
3. Ig A (sIg A)
4. Ig E
5. Ig D

- Ig G (80% serum Ig). They are formed at the height of the primary immune response and the immune response again. It penetrates through the placenta to the fetus.
- ▪ Ig M (13%). The first start synthesized in the body of the fetus and the first to appear in the serum after immunization. Do not cross the placenta.
- ▪Ig A (40%) is synthesized by plasma cells in the spleen and lymph nodes. The average concentration of them - 2.5 g / l.
- Ig D (75%) did not cross the placenta. They can play a role in the malignant transformation of cells.
- Ig E (0,00025 g / tracks) synthesized by plasma cells and are involved in anaphylactic reactions (reagin).

applied immunology

- **Vaccines and toxoids - drugs to induce the body's specific immune response by mobilizing mechanisms of immunological memory**

- **Immune serum and immunoglobulins - preparations containing completespecific antibodies, the introduction of which in the organism leads to the immediate acquisition of passive humoral immune response.**

Vaccination: A vaccination is an injection of a weakened form of the actual antigen that causes the disease. The injection is too weak to make you sick, but your B lymphocytes will recognize the antigen and react as if it were the "real thing". Thus, you produce MEMORY cells for long term immunity.

REQUIREMENTS FOR VACCINES

- High immunogenicity (ability to provide reliable anti-infectious protection)
- AREAKTOGENNOST (no significant side reactions)
- HARMLESSNESS
- MINIMUM sensitizing effect

CLASSIFICATION OF VACCINES

- **According to methods preparation**
- Live (attenuated)
- Inactivated
- anatoxins
- Chemicals
- Recombinant
- Genetic engineering
- Anti-idiotype in progress
- liposomal development
- Bacterial
- viral

Living vaccine

These drugs are made from live but weakened (attenuated virulence) microbes retained immunogenicity. These vaccines are characterized by high efficiency, as cause in the body similar to the natural process of infection, but without clinical manifestations. When this vaccine strain may persist and multiply in the body. Typically, once introduced.

Benefits:

- **A single injection**
- **Prolonged immunity**

Disadvantages:

- In a weakened organism can cause infections

Killed vaccine

This suspension of killed microbes in nat. solution. To inactivate microbes are used:

1. Elevated Temperature (56-58 ° C)

2. The chemicals (ethyl alcohol, formalin, acetone, phenol)

3. UFO

Benefits:

They do not cause infectious disease in a weakened body

Disadvantages:

- **repeated administration**
- **Immunity non-durable**

CHEMICAL VACCINE

This product containing the active bacteria derived from bacteria by various treatments, in particular by enzymes (pancreatin, trypsin). These less reactogenic vaccine, a storage stable, more immunogenic. They are made of several kinds of microbes, i.e. they are integrated (associates). The advantage of them in a sharp reduction in the number of injections, while maintaining the amount of antigen administered. Usually they are administered singly.

In order to antigens not quickly absorbed into the body and provide long-lasting immunity, they added absorbent material (aluminum hydroxide adjuvant, phosphate, aluminum)

ANATOXINS

It is neutralized exotoxin which produced by the action of formalin solution. It contains many ballast substances. Currently uses purified toxoids adsorbed to the adjuvant. This toxin loses its virulence, but retains the ability to induce the synthesis of antitoxic antibodies.

Diphtheria toxoid adsorbed purified

Staphylococcal toxoid

Tetanus toxoid adsorbed purified

DT - toxoid

Polianatoksin peeled

Anatoxins connected with corpuscular AG (DTP cholera vaccine)

Immune serum and immunoglobulins

This preparations the introduction in the body which creates artificial passive immunity acquired. Immunity is created quickly, but lasts a short time, because introduced protein is rapidly degraded.

Sera have immediate effect, neutralizing toxins, destroying the bacteria themselves. Therefore, they are mainly used for the treatment and prophylaxis less.

Often introduced by intramuscular injection.

Serum products are divided into:

- **Heterologous (obtained from blood of animals)**
- **Homologous (derived from human blood)**
- **heterologous:**
  - **Immunization of animals**
  - **The high concentration of antibodies**
  - **Unlimited selection of producers**
  - **The high immunogenicity of the (alien) -**
  - **especially when using**

homologous:

- **are not immunogenic**
- **From the donor or from placental blood**
- **AT concentration is not great. This may include other antibodies.**

Immunoglobulins

It is highly purified, concentrated gamma globulin human and animal.

2 types:

Normal (obtained from the donor, abortive, placental blood)

measles

polio

pertussis

2. The direction of action (immune sera obtained from human donors and animals)

Against rabies

smallpox

tetanus

diagnostic drugs

This diagnostic serum and diagnostic tools designed for the production of diagnostic reactions.

Diagnosticums - a suspension of killed bacteria of some kind. Their variety - erythrocyte diagnostic tools (bacterial AG adsorbed on erythrocytes).

Diagnostic serum - antibodies obtained by immunizing animals (rabbits, sheep) the relevant AG.

Allergens - preparations for the production of skin tests and detection of allergic conditions. Show infection of the body.