FEDERAL STATE BUDGETARY EDUCATIONAL INSTITUTION
OF HIGHER EDUCATION
«BASHKIR STATE MEDICAL UNIVERSITY»
OF THE MINISTRY OF HEALTHCARE OF RUSSIAN FEDERATION

DEPARTMENT REPRODUCTIVE HUMAN HEALTH

WITH COURCE OF IMMUNOLOGY

APPROVED by
Head of the department

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Methodical recommendations For students
to the practice session on the topic:
«Forms of immune response. Immuno-diagnostic reactions.
Intercellular cooperation in the immune response. Immunological reactions involving complement.»

Discipline: Immunology
Specialty: 31.05.03. «Dentistry »
Course 2
Semester 3
Hours: 4 Hours

Ufa - 2021

Methodological instructions for students for practical lessons in the discipline "Immunology " were developed by the faculty of the department in accordance with the work program of the academic discipline (Ufa, 2021), the curriculum (2021) and taking into account the requirements of the Federal State Educational Standard of Higher Education 3 ++ according to specialty 31.05.03 Dentistry (M., 2020).

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1. The theme and its relevance:

“Intercellular cooperation in the immune response. Forms of immune response. Immunological memory. Immunological tolerance. Cytokines”

The immune response occupies the most important place in the section of theoretical immunology, as the immune response provides specific protection of the body from genetically alien agents and ensures the consistency of the internal environment of the body. Disorders of the immune response lead to the development of various diseases (infectious, oncological, allergic, autoimmune and others). Knowledge of the specifics of cell cooperation in the immune response is necessary for understanding the pathogenesis of various diseases, their diagnosis and treatment. Knowledge of the principles of the immune response in the normal, as well as the causes and mechanisms of the development of damage to the immune defense of the body are necessary for the doctor to diagnose and prescribe ethiopathogenic therapy in a timely manner, develop and take effective measures prevention and prevention of immune aggression, ensuring quality immunological surveillance and ensuring biological stability ... The immune response consists of a complex series of cellular interactions activated by the intake of foreign antigenic material. After treatment with macrophages, the antigen is represented by lymphocytes, which are the main cells of the immune system's executive branch. Activation of lymphocyte antigen leads to the proliferation and transformation of lymphocytes.

There are two main types of immune response:

1. Cell immunity is a function of T-lymphocytes; in cellular immunity, effective cells - T-killers that are able to destroy cells that have an antigenic structure through direct cytotoxicity and by the synthesis of certain substances called lymphocanes, which are involved in cell interaction processes (macrophages, T-cells, B-cells) in immune response. In addition, two subtypes of T-cells are involved in regulating the immune response: T-helpers enhance the immune response; T-suppressors have the opposite effect.

The cell-mediated response involves mostly T cells and responds to any cell that displays aberrant MHC markers, including cells invaded by pathogens, tumor cells, or transplanted cells. The following chain of events describes this immune response:

1. Self cells or APCs displaying foreign antigens bind to T cells.
2. Interleukins (secreted by APCs or helper T cells) costimulate activation of T cells.
3. If MHC-I and endogenous antigens are displayed on the plasma membrane, T cells proliferate, producing cytotoxic T cells. Cytotoxic T cells destroy cells displaying the antigens.
4. If MHC-II and exogenous antigens are displayed on the plasma membrane, T cells proliferate, producing helper T cells. Helper T cells release interleukins (and other cytokines), which stimulate B cells to produce antibodies that bind to the antigens and stimulate nonspecific agents (NK and macrophages) to destroy the antigens

2. Humoral immunity is a function of B-cells and is characterized by the conversion of B-cells into plasma cells that secrete immunoglobulins (antibodies), which have specific activity against the introduced antigen. Forms of immune response: Antibody formation. Immune phagocytosis. Killer function of lymphocytes. Allergies, immediate hypersensitivity and hypersensitivity.

The humoral response (or antibody-mediated response) involves B cells that recognize antigens or pathogens that are circulating in the lymph or blood (“humor” is a medieval term for body fluid). The response follows this chain of events:

1. Antigens bind to B cells.
2. Interleukins or helper T cells costimulate B cells.In most cases, both an antigen and a costimulator are required to activate a B cell and initiate B cell proliferation.

3. B cells proliferate and produce plasma cells.The plasma cells bear antibodies with the identical antigen specificity as the antigen receptors of the activated B cells.The antibodies are released and circulate through the body, binding to antigens.
4. B cells produce memory cells.Memory cells provide future immunity.

Antigen processing - processing of an antigen by antigen-presenting cells into an immunogenic form and presenting it to immunocopmetent cells. B-lymphocytes, DC, and T-lymphocytes participate in the processing along with the macrophage. Processing is understood as such processing of an antigen, as a result of which the peptide fragments of the antigen (epitopes) necessary for the transmission (presentation) of the antigen are selected and bound to MHC-II class (or MHC-I) proteins. In this complex form, antigenic information is transmitted to lymphocytes.

Intercellular adhesion molecules: selectins, mucin-like vascular addressins, integrins, cadherins, homing receptors, and molecules from the Ig superfamily.
The mobilization of white blood cells to the site of infection is stimulated by proinflammatory cytokines, and is mediated by adhesion molecules on the surface of white blood cells and endothelial cells, as well as chemokine molecules and their receptors.
Proinflammatory cytokines (α-TNF, IL-1) are produced and secreted by macrophages during phagocytosis of the pathogen. Under the action of these cytokines, adhesion molecules appear on the surface of endothelial cells, first for neutrophils, and then for monocytes and lymphocytes, responsible for the adhesion of white blood cells to the vascular endothelium. In addition, cytokine-activated endothelial cells produce chemokines that reach a high concentration at the level of the infection site.
Regulation of the immune response by cytokines.
1. Intracrine mechanism - the action of cytokines inside the producing cell; binding of cytokines to specific intracellular receptors.
2. Autocrine mechanism - the action of the secreted cytokine on the secreting cell itself. For example, IL-1, -6, -18, and TNF-α are autocrine activating factors for monocytes and macrophages.
3. Paracrine mechanism - the action of cytokines on nearby cells and tissues. For example, IL-1, -6, -12, -18, and TNF-α produced by macrophages activate T-x , which recognizes the antigen and MHC of the macrophage.
4. The endocrine mechanism - the action of cytokines at a distance from the producing cells. For example, IL-1, -6 and TNF-α, in addition to auto-and paracrine effects, can have a distant immunoregulatory effect, a pyrogenic effect, induction of acute phase protein production by hepatocytes, symptoms of intoxication and multi-organ lesions in toxic-septic conditions.

In any form, the immune response is the result of the interaction of different types of cells: macrophages, T-and B-lymphocytes.

2. Learning purpose: mastering knowledge about the concept of Immunity, types. Factors of non-specific resistance, knowledge of pathogenesis of each type of reaction and clinical manifestations.

To form professional competencies, the student must know:
- Anatomy-physiological features of non-specific resistance;
- the role of each factor of non-specific resistance in anti-infective protection;
- clinical manifestations of insufficiency of various factors of nonspecific resistance.

To form professional competencies, the student must be able to:
- determine the intensity of innate immunity;
- detect the presence of agglutination and establish the titer of normal antibodies;
- collect anamnesis, determine the plan of examination of the patient by organs and systems, which will allow to assess the functioning of factors of nonspecific resistance of the immune system;
- determine the plan for additional examination of the patient;
- evaluate the results of clinical and laboratory-instrumental data;
- master the following competencies: GC 1, GC 6, GPC 5, PC 1, PC 5.

3. Materials for self-preparation to master this topic:

Self-training questions:

1. Forms of the immune response (antibody formation, immune phagocytosis, killer function of lymphocytes, immunological memory and tolerance).
2. Immunological tolerance, types.
3. Name the types of immune response.
4. Name the types of humoral immune response.
5. Which cells can represent antigenes (AG)?
6. What cells does thymus-dependent AG interact with?
7. Describe the concept of processing AG.
8. What signals are required for activation of lymphocytes?
9. What classes of immunoglobulins are synthesized in thymus-dependent AG during the primary immune response?
10. What classes of immunoglobulins are synthesized in the secondary immune response?
11. What is immunological memory?
12. In what cases are formed memory cells?
13. Describe the concept of primary and secondary immune response.
14. Describe the mechanisms of development of a cytotoxic response.
15. What cytokines are involved in the development of cellular cytotoxicity reactions?
16. Regulation of the immune response by cytokines. Pro-and anti-inflammatory cytokines.
17. Examples of the practical use of cytokines.

4. Type of lesson: practical lesson
5. Duration: 4 hours
6. Equipment: computer, projector
7. The content of the lesson.

7.1. Control of the initial level of knowledge and skills. Self-control assignments: students' decision on individual sets of test assignments on the topic

Tests. Variant 1.

1. Types of immune response:

1) Natural, artificial,
2) Cellular, humoral,
3) Active, passive,
4) Direct, indirect.

2. Cells with antigen-presenting properties:

1) T-helpers,
2) T-killers,
3) B-lymphocytes,
4) monocytes,
5) eosinophils.

3. Cytokines are

1) lipid regulators of cellular activity;
2) protein molecules that recognize foreign structures;
3) protein molecules that regulate the functions of cells of the immune system and organize the emigration of white blood cells;
4) biologically active compounds that cause apoptosis of altered cells;
5) hormones secreted by macrophages.

4. After the recognition of antigens, B-lymphocytes differentiate into:
1) Suppressors,
2) Helpers,
3) Antigen-presenting cells,
4) Plasmocytes,
5) Monocytes.

5. Cytokines are divided into:
1) antiviral, antibacterial;
2) pro-inflammatory, anti-inflammatory;
3) cellular, humoral;
4) slow, immediate action.

6. A T-helper cytokine that stimulates the proliferation and differentiation of other T – cell subpopulations:
1) Interleukins
2) Interleukin 2
3) Interleukin 3
4) ÌL – 6
5) ÌL – 5

7. T-cytotoxic lymphocytes recognize antigens:
1) In free form
2) In association with class 2 HLA AG
3) Denatured form
4) In association with class 1 HLA AG
5) Only in connection with macrophages

8. Anti-inflammatory cytokines include:
1) Interleukin 1,
2) Interleukin 2,
3) Interleukin 4,
4) tumor necrosis factor,
5) interferon gamma.

Tests. Variant 2.

№ пп	Tests. Lesson 4
1	Cells that determine the specific nature of the immune system response: 1.Macrophages 2.Lymphocytes 3.Monocytes 4.Granulocytes 5.Mast cells
2	Cells that are not related to the accessory cells of the immune response: 1.Monocytes 2.Macrophages 3.The plasma cells 4.Dendritic cells

	5.A-cells
3	Central organs of the immune system: 1.Spleen 2.Bone marrow 3.Blood 4.Tonsils 5.Thymus
4	The single precursor of the immune system cells is: 1.Epithelial cell 2.Stem cell 3.Myeloblast 4. Endotheliocyte
5	Markers of T-killers: 1.HLA - A 2.HLA - DR 3.CD - 3 4.CD - 8 5.CD - 4
6	The lymphoblast is: 1.Lymphocyte in the final phase of differentiation 2.A lymphocyte with cytotoxic effector properties 3.Precursor of mature lymphocytes 4.Lymphocyte in the phase of intensive reproduction
7	The following cells have antigen-reducing properties: 1.Natural Killers 2.Langerhans 3. Dentritic cells 4.Monocytes 5.B-lymphocytes
8	Macrophages have receptors for: 1. Fc-IgG 2.Fc – IgA 3.Complement 4.Cytokines 5.Red blood cells
9	The main functions of the macrophage: 1. Phagocytosis 2.Presentation of the antigen to T cells 3.The secretion of cytokines 4.Damage to the target cells 5.Production of antibodies
10	The composition of the active center of antibodies includes the following domains: 1.Variable " H "and constant" L " - chains 2.Variable " L "and constant" H " - chains 3.Variable "H" and " L " - chains 4.Constant "H" and " L " - chains
11	The active centers of antibodies are formed due to the sites: 1.Two " H " chains 2.Two " L " chains

	3.One " H " - chain 4.One " L " - chain 5.One " H "and one" L " chain
12	T-helper cells: 1.Have an antigen-recognizing receptor 2.They have a coreceptor SD 4 3.They are responsible for the development of cellular immunity 4.They are responsible for the development of humoral immunity5.Inhibit T-helper cells
13	The part of the antibody molecule responsible for activating the complement: 1.the" L " chain 2.FC fragments 3.FAB Fragments 4.The active centers 5.H-chains
14	Cytokines are: 1.Proteins formed by activated cells of the immune system 2.Interferons 3.Interleukins 4. Leikins
15	Immunoglobulin M -: 1. Pentamer 2. Dimer 3. Participates in the activation of complement 4. Transmitted through the placenta
16	Mechanism of anti-virus activity of T-killers: 1.Cytolysis of virus-infected cells 2.Apoptosis of infected cells 3.Gamma-interferon production 4.Antibody-dependent cellular cytotoxicity
17	In the primary immune response, 1.only Ig M is produced. 2.IgG Only 3.First IdM, then IgG
18	At the first stage of serological reactions occurs: 1.Agglutination 2.The precipitation of 3.Connection of AG with AT 4.Lysis 5.Binding of complement
19	T - helper cells recognize: 1. Antigens associated with HLA cl. I proteins 2. Antigens represented by macrophages 3. The determinant of the native antigen 4. Short peptides associated with HLA cl. II antigens 5. Antigens associated with HLA cl. II antigens
20	Which of these organs are directly related to the processes of immunogenesis? 1. Lungs 2. Bone marrow 3. Liver

	4. The Kidneys.
21	The main cells that regulate the immune response are: 1. T-helper cells 2. Macrophages 3. T-suppressors 4. T-killers 5. B-lymphocytes

Typical tasks.

Variant 1.

Task №1.

Specify which statements are correct and which are incorrect. Explain the error of each statement that you think is incorrect.

1. T cells develop from hematopoietic stem cells.
2. Plasma cells, T-killers, and T-suppressors are examples of effector cells.
3. B cells mature in the thymus.
4. Antigens entering the blood are captured by macrophages in the spleen.
5. Hapten can stimulate the synthesis of antibodies, but cannot interact with them.
6. Both cellular and humoral immune responses play a role in protecting the host body from viral infections.
7. T cells secrete antibody molecules.

Task №2.

1. Specify which statements are correct and which are incorrect. Explain the error of each statement that you think is incorrect.

2. 1. The active center of the immunoglobulin is formed by a light chain.
3. 2. A certain antigen causes the synthesis of one type of antibody.
4. 3. IgM is the main class of antibodies synthesized in the secondary immune response.
5. 4. Antibodies are not formed in response to the molecules of their own body, because the genes encoding information for the synthesis of autoantibodies are not inherited.
6. 5. Antigenic stimulation of macrophages in the thymus causes their differentiation into T cells.
7. 6. Activation of the third component of complement C3 occurs only if the antigen interacts with a specific antibody of the class that can bind the complement.
8. 7. Injuries that occur with delayed-type hypersensitivity are cellular infiltrates containing lymphocytes and macrophages.
9. 8. In the presence of an antigen, purified populations of T and B cells can cooperate in vitro, causing

Typical tasks. Variant 2.

Task 1. In humans, lymphocytes differentiate in the lymphoid tissue of the intestine, appendix, tonsils, and palatopharyngeal ring. Name the type of lymphocytes.

Task 2. In the respiratory tract, liver, peritoneum, spleen, lymph nodes are constantly large long-lived cells of the immune system. What kind of cells are we talking about?

Task 3. In the chest cavity under the sternum is the gland of internal secretion, it is also an organ of the lymphatic and immune system, which ensures the differentiation of lymphocytes into T-lymphocytes. What kind of hardware are we talking about?

Task 4. To develop passive immunity, a therapeutic serum is administered to a person. What does the therapeutic serum contain in this case?

Task 5. To develop artificial immunity, weakened, killed infectious agents or their fragments are introduced into the human body. Name this method of developing artificial immunity.

7.2. Analysis with the teacher of the key questions necessary for the development of the topic of the lesson.
7.3. Presentation by the teacher of the methodology for assessing the state of factors of non-specific protection of the body in the laboratory.
7.4. Independent work of students under the supervision of a teacher (draw in a notebook the stages of phagocytosis, the main schemes of complement activation).
7.5. Control of the final level of assimilation of the topic:
The teacher checks the students ' oral answers to the questions of self-preparation.
Checking the presence of drawings of phagocytosis stages and the main schemes of complement activation in the notebooks.
Materials for monitoring the level of development of the topic:
- a set of test tasks,
- situational tasks.
Place of self-training: study room for independent work of students.
Educational and research work of students on this topic (conducted during school hours): working with the main and additional literature.
The main literature

Serial№	**Title**	**Author(s)**	**Year, place of publication**	**Number of copies**	
				In library	At the department
1	2	3	4	7	8
	Basic Immunology: Functions and Disorders of the Immune System [Текст] : [учебноеиздание]	**A. K. Abbas, A. H. Lichtman, S. Pillai.**	Elsevier, 2016 – 335 p.	80	0

Additional literature

Serial №	**Title**	**Author(s)**	**Year, place of publication**	**Number of copies**	
				In library	At the department
1	2	3	4	7	8
•	Lectures in immunology: курс лекций	Maianskii, A. N.	N. Novgorod: Publishing house NSMA, 2004 – 256 p.	40	0
•	**IMMUNOLOGY**	**Khaitov R.M.**	**2008 – 256 c.on-line.**	**access mode:** ЭБС «Консультант студента» http:// www.studmedlib .ru/book/ ISBN9785970407042.html	unlimited access
•	**Fundamental Immunology.**	**Lippincott Williams & Wilkins**	**2008 –on-line**	**access mode:** Database«LWW	unlimited access

				Medical Book Collection 2011» http:// ovidsp .ovid.com	