

**MINISTRY OF SCIENCE AND HIGHER EDUCATION
RUSSIAN FEDERATION**

**FEDERAL STATE AUTONOMOUS EDUCATIONAL INSTITUTION OF
HIGHER EDUCATION
NORTH-CAUCASUS FEDERAL UNIVERSITY**

Methodological Guidelines
for Students on arranging and performing independent work
in the Discipline of Pharmacology
for Students majoring (Specialty) in 31.05.01 General Medicine

Methodological Recommendations for Studying Theoretical Material

When performing the independent study of theoretical material, the student must follow the rules as set below. The working curriculum of the respective academic discipline shall be recommended to be used as the basis for such activity. According to the schedule of classroom lessons and independent work, a different number of hours is to be allocated for studying individual topics. A significant portion of the student's independent work should be allocated to mastering the material on the covered topic, writing a summary (notes) on the specified theoretical blocks, and searching for additional literature based on the NCFU library and via the Internet system. The lecture material shall not cover all theoretical material; the greater part of it must be mastered through independent work. Given the above, working with the recommended literature is mandatory. Special attention must be paid to the content of the main provisions and conclusions, the explanation of phenomena and facts, and the understanding of the practical application of the theoretical issues under consideration. In the process of this work, the student should strive to understand and memorize the main provisions of the material being considered, the examples illustrating it, as well as to understand the illustrative material. Preparation should be completed by drawing up a plan (summary/notes) on the material (issue) being studied. This allows for the creation of a concentrated, concise representation of the issues being studied. First, studying the recommended literature is to be done. Special attention must be paid to the content of the main provisions and conclusions, the explanation of phenomena and facts, and the understanding of the practical application of the theoretical issues under consideration.

During this work, the student should strive to understand and memorize the main provisions of the material being considered, the examples illustrating it, as well as to understand the illustrative material. Preparation should be completed by drawing up a plan (summary/notes) on the material (issue) being studied. This allows for the creation of a concentrated, concise representation of the issues being studied. If necessary, one should seek (advice) consultation from the instructor. When going to a consultation, it is necessary to thoroughly think through the questions that require clarification. Keeping records contributes to turning reading into an active process, mobilizing motor memory along with visual memory. The following should be born in mind: a student who systematically keeps records creates their own individual stock of auxiliary materials for a quick review of what has been read and for the mobilization of accumulated knowledge. Records are especially important and useful when they reflect the thoughts that arose during independent work.

It is important to develop the students' capacity to compare sources and to think through the material being studied.

Improving note-taking skills among students is of great importance.

The instructor may recommend the following main forms of recording to students: a plan (simple and detailed), excerpts, and theses (abstracts).

The results of note-taking can be presented in various forms.

- A plan is an outline of the read material, a brief (or detailed) list of questions reflecting the structure and sequence of the material.
- A detailed plan fully replaces a summary.
- A summary (notes) is a systematized, logical presentation of the source material. Four types of summaries are distinguished:
 - Outline-summary (Plan-notes) – this is an expanded, detailed plan in which sufficiently detailed records are provided for those points of the plan that need explanation.
 - Textual summary – this is the reproduction of the most important provisions and facts of the source.
 - Free summary – these are clearly and briefly formulated (stated) main provisions resulting from a deep understanding of the material. It may contain excerpts, quotations, and theses; part of the material may be represented by a plan.

- Theme-based summary – this is compiled on the basis of studying a number of sources and gives a more or less exhaustive answer according to a certain scheme (issue).

Methodological Guidelines for the Preparation for Practical Activities

When preparing for practical activities, the recommendation implies studying the control questions for the given lesson and the theoretical material from one's own notes.

The main form of work during the lessons is an interview (discussion). Each student must be ready to speak on all issues raised in the plan and demonstrate maximum activity during their consideration.

The speech must be constructed freely, convincingly, and with arguments. The instructor ensures that the speech is not reduced to a reproductive level (simple reproduction of the text); simple reading of the summary is also not allowed.

It is necessary for the speaker to show their own attitude towards what they are talking about, express their personal opinion and understanding, substantiate it, and be able to draw the correct conclusions from what has been said. In doing so, the student may refer to the entries in the summary, directly to the primary sources, use knowledge of previously studied disciplines, etc. In addition, to obtain a grade at an advanced level, students solve situational tasks based on the results of the mastered topics.

During the execution of practical works, a defense of practical skills is provided, the full list of which is specified in the fund of assessment tools.

Methodological Recommendations for the Preparation of Presentations and Reports

The report must contain elements of novelty; along with the fundamental aspect, an analysis of the current state of the problem under study must be carried out, as well as inclusion in regional issues. The report must include an introduction, a theoretical part, a conclusion, a list of literature, and a presentation that reveals the essence of the topic in graphs, pictures, diagrams, and formulas.

The report is recommended to be submitted on 1 printed sheet. The text of the work must be printed with 1.5 line spacing on one side of a standard sheet (A4) of white paper.

The text and other printed elements of the work must be black, and the contours of letters and signs must be clear, without halos and shading. The font must be Times New Roman, size 14. The titles of chapters and paragraphs are highlighted in bold. The sheet with text must have margins: left – 30 mm, right – 10 mm, top – 20 mm, bottom – 20 mm.

Page numbering of the text is done in the lower right corner of the sheet. It is necessary to number pages starting from the page where the Introduction is printed, on which the number 3 is placed. After that, all pages, including appendices, are numbered.

A space equal to two intervals is placed between the title of the chapter and the title of the paragraph of this chapter, and the title of the paragraph must not be separated from the text of this paragraph by a space. The titles of paragraphs shall be separated from the text of the previous paragraph by a space equal to two intervals. Each chapter, as well as the introduction, conclusions, appendices, and the list of used literature, begin on a new page. The word Chapter is not to be written. Chapters have ordinal numbers within the entire work, designated by Arabic numerals (for example: 1, 2, 3), followed by a period.

The word **PARAGRAPH** or the paragraph symbol (§) is not placed in the title. Paragraphs have ordinal numbers within the chapters, designated by Arabic numerals (for example: 1.1. and 1.2.).

Headings of chapters and paragraphs in the text must be centered; a period shall not be placed at the end of the title of the chapter and paragraph. It is not allowed to hyphenate (transfer) a part of a word in a heading. 4.5. The numbering of tables and figures can be running (continuous) or relate to the number of the chapter and paragraph. For example, if a table or a figure is included in the text of the first paragraph of the second chapter, the numbering is as follows: Table 2.1.1., Fig. 2.1.1.

The last digit means the ordinal number of the table (or figure) in this paragraph.
The table is to be placed as the next page after the first mention of it in the text.

Aim and Objectives of Mastering the Discipline (Module)

- Aim of mastering the discipline Pharmacology to develop systematic knowledge, professional and general scientific competencies of future specialists in the programme 31.05.01 General Medicine concerning the use of medicinal products, their classification into pharmacotherapeutic groups, indications and contraindications for use, interchangeability of medicinal products and principles of rational administration; to form the ability and readiness to provide information and consultative services regarding the use and compatibility of medicinal products (MPs).
- Objectives of mastering the discipline Pharmacology:

to cultivate proficiency in working with diverse reference literature in pharmacology, product monographs, and the ability to navigate medical handbooks by nosology;

to develop professional competences in synthesizing information on established and novel medicinal products, as well as data on pharmacoprophylaxis and pharmacotherapy of specific diseases.

Theme 1

Introduction to the pharmacology course. Pharmacological classification of medicinal products. The medical prescription. Pharmacokinetics of medicinal substances.

Aim

To introduce students to the foundational principles of pharmacology, prescription writing regulations, and the quantitative aspects of drug absorption, distribution, metabolism, and excretion (ADME) within the human body.

Control Questions

1. Define the terms «pharmacokinetics» and «pharmacodynamics» and explain their key differences.
2. Explain the structural parts of a classic medical prescription (e.g., Inscriptio, Subscriptio, Signatura).
3. Describe the main mechanisms of drug transport across biological membranes (passive diffusion, active transport, facilitated diffusion).
4. Define «bioavailability» and explain how it is calculated and what factors influence it.
5. What is the «first-pass effect» (presystemic elimination) and which routes of administration bypass it?
6. Define «apparent volume of distribution» (V_d) and explain what a high V_d value (exceeding total body water) signifies.
7. How does the binding of drugs to plasma proteins (such as albumin) affect their distribution and pharmacological activity?
8. Differentiate between Phase I (nonsynthetic) and Phase II (synthetic) metabolic reactions in the liver.
9. What is the clinical significance of a drug's half-life ($t_{1/2}$)?
10. Define «clearance» (Cl) and write the mathematical relationship between clearance, volume of distribution, and half-life.
11. Compare first-order elimination kinetics with zero-order elimination kinetics, giving examples of drugs for each.

12. How does urine pH affect the renal excretion of weak acids (e.g., aspirin) and weak bases (e.g., amphetamine)?

Theme 2

Pharmacodynamics of medicinal products. Routes of administration. The movement of medicinal substances in the organism. Principles of pharmacogenetics. Dosing, combination and repeated administration of medicinal products.

Aim

To study the molecular mechanisms of drug action, receptor-effector systems, the influence of genetic factors on drug response, diverse routes of administration, and the consequences of drug combinations and repeated dosing.

Control Questions

1. Describe the four major families of receptors (ionotropic, metabotropic, kinase-linked, and nuclear receptors).
2. Define and compare: agonist, partial agonist, antagonist (competitive and non-competitive), and inverse agonist.
3. What is the "therapeutic index" (TI) and how does it relate to drug safety?
4. Compare the clinical advantages and disadvantages of enteral (oral, sublingual, rectal) and parenteral (IV, IM, SC) routes of administration.
5. Explain the physiological mechanism of receptor desensitisation and down-regulation.
6. What is "tachyphylaxis" and how does it differ from chronic drug tolerance?
7. Explain the term "idiosyncrasy" and provide a classic clinical example.
8. How do genetic polymorphisms in drug-metabolizing enzymes (e.g., CYP2D6) lead to variations in therapeutic response?
9. Describe the difference between additive synergism and potentiation synergism.
10. Explain chemical, physiological, and pharmacological drug antagonism with examples.
11. What is a "loading dose" and under what clinical circumstances is it indicated?
12. How is a "maintenance dose" calculated using systemic clearance and bioavailability?
13. Describe the role of P-glycoprotein (MDR1) in drug transport across the blood-brain barrier.
14. How do pediatric and geriatric age-related physiological changes affect drug pharmacodynamics?
15. What is physical and chemical drug incompatibility in a single syringe, and how can it be prevented?

Theme 3

Continuation of pharmacodynamics; routes of administration; pharmacokinetics; pharmacogenetics; dosing and combined administration.

Aim

To deepen the quantitative understanding of drug-receptor kinetics, advanced pharmacokinetic models, clinical pharmacogenetics, and the risks associated with polypharmacy and drug interactions.

Control Questions

1. Explain the "operational model" of drug agonism (the Black-Leff model).
2. What are "spare receptors" and how can their presence be verified experimentally?
3. Discuss the clinical consequences of cytochrome P450 enzyme induction vs. enzyme inhibition, providing examples of clinical interactants.
4. Describe the process of enterohepatic circulation and how it influences a drug's duration of action.
5. How should dosing regimens be adjusted in patients with severe renal impairment (e.g., based on creatinine clearance)?
6. Define "steady-state concentration" (C_{ss}) and explain how many half-lives are required to reach it during continuous dosing.
7. Explain why the sublingual route of administration provides a rapid systemic effect compared to the oral route.
8. What is the pharmacogenetic basis of suxamethonium (succinylcholine) apnea?
9. Define "polypharmacy" and discuss its primary risks in geriatric pharmacotherapy.
10. Describe the difference between pharmaceutical, pharmacokinetic, and pharmacodynamic drug-drug interactions.
11. What is "therapeutic drug monitoring" (TDM) and what are the primary indications for its use?

Theme 4

Agents acting on cholinergic and adrenergic synapses.

Aim

To analyze the physiology of the autonomic nervous system and master the pharmacology, therapeutic indications, and side effects of agents acting on cholinergic and adrenergic synapses.

Control Questions

1. Detail the biosynthesis, storage, release, and enzymatic termination of acetylcholine in the synapse.
2. Classify cholinergic receptors (M_1 through M_5 , N_M , and N_N), listing their primary anatomical locations and secondary messengers.
3. Explain the mechanism of action, ocular effects, and clinical indications of pilocarpine.
4. Classify anticholinesterase (AChE) inhibitors into reversible and irreversible groups, providing clinical examples.
5. Describe the clinical presentation of organophosphate poisoning (SLUDGE syndrome) and its specific antidotal therapy.
6. What are the pharmacological effects of atropine on the eye, heart rate, salivary glands, and bronchiolar smooth muscle?
7. List the primary clinical indications and contraindications for M-cholinergic blockers.
8. Describe the biosynthetic pathway of catecholamines starting from L-tyrosine.
9. Classify adrenergic receptors (α_1 , α_2 , β_1 , β_2 , β_3) and detail their primary cardiovascular and respiratory functions.
10. Compare the cardiovascular effects (heart rate, blood pressure, peripheral resistance) of epinephrine, norepinephrine, and isoproterenol.
11. What are the clinical uses and typical side effects of selective β_2 -adrenoceptor agonists (e.g., salbutamol)?
12. Explain the mechanism of action and clinical indications of prazosin.
13. Classify β -blockers based on cardioselectivity, intrinsic sympathomimetic activity (ISA), and vasodilating properties.

14. What are the absolute contraindications for prescribing non-selective β -blockers (e.g., propranolol)?

Theme 5

Agents for local anaesthesia.

Aim

To study the classification, molecular mechanisms, pharmacokinetic characteristics, and toxicological profiles of local anaesthetic agents used in clinical practice.

Control Questions

1. Describe the molecular mechanism of action of local anaesthetics on voltage-gated sodium channels.
2. Classify local anaesthetics into esters and amides, and explain how this chemical difference affects their metabolism and allergy risk.
3. Why is a vasoconstrictor (e.g., epinephrine) frequently co-administered with a local anaesthetic?
4. How does local tissue pH (e.g., in an inflamed, acidic area) affect the clinical efficacy of local anaesthetics?
5. Describe the sequence of block of different nerve fiber types (sensory, motor, autonomic) by local anaesthetics.
6. Compare the duration of action and lipid solubility of lidocaine, bupivacaine, and procaine.
7. What is "Local Anaesthetic Systemic Toxicity" (LAST) and what are its primary central nervous system and cardiac symptoms?
8. Explain the role of intravenous lipid emulsion (lipid rescue) in the management of bupivacaine-induced cardiotoxicity.
9. Which local anaesthetics are preferred for topical (surface) anaesthesia and why?
10. Explain the metabolism of ester-type local anaesthetics by plasma cholinesterases and the formation of para-aminobenzoic acid (PABA).

Theme 6

Agents for general anaesthesia.

Aim

To analyze the classification, pharmacodynamics, stages of anaesthesia, and clinical profiles of inhalation and intravenous general anaesthetic agents.

Control Questions

1. Explain the Meyer-Overton hypothesis of general anaesthesia and discuss its limitations in modern molecular pharmacology.
2. Describe the primary ligand-gated ion channels (e.g., $GABA_A$, NMDA, glycine receptors) targeted by general anaesthetics.
3. Define "Minimum Alveolar Concentration" (MAC) and explain how it is used to measure the potency of inhalation anaesthetics.
4. How do the blood-gas and oil-gas partition coefficients of an inhalation anaesthetic affect the speed of induction and recovery?
5. Compare the clinical profiles, advantages, and risks of halothane, isoflurane, and sevoflurane.

6. What is malignant hyperthermia, what triggers it, and what is its specific pharmacological treatment?
7. Describe the pharmacodynamic and pharmacokinetic properties of propofol, including its suitability for day-surgery.
8. Explain the term "dissociative anaesthesia" and describe the pharmacology, indications, and side effects of ketamine.
9. Compare the haemodynamic effects of thiopental sodium and etomidate during the induction of anaesthesia.
10. Define "balanced anaesthesia" and list the classes of drugs typically combined to achieve it.
11. Discuss the clinical uses and side effects of nitrous oxide, including the risk of diffusion hypoxia.
12. How does the "second gas effect" facilitate the uptake of halogenated anaesthetics when administered with nitrous oxide?

Theme 7

Analgesics. Hypnotics. Anticonvulsants and antiparkinsonian agents.

Aim

To examine the pharmacology of opioid and non-opioid analgesics, sedative-hypnotic drugs, antiepileptic agents, and drugs used to treat Parkinson's disease.

Control Questions

1. Classify opioid receptors (μ , κ , δ) and describe their intracellular G-protein-coupled signaling pathways.
2. Detail the central and peripheral pharmacological effects of morphine.
3. What is the classic clinical triad of acute opioid poisoning and what is the specific antidote?
4. Compare the potency, duration of action, and clinical indications of morphine, fentanyl, and loperamide.
5. Explain the mechanism of action of paracetamol (acetaminophen) and how it differs from traditional NSAIDs.
6. Classify hypnotic agents into benzodiazepines, non-benzodiazepines (Z-drugs), and barbiturates.
7. Compare the effects of benzodiazepines and barbiturates on the chloride channel opening kinetics of the $GABA_A$ receptor.
8. What are the primary safety advantages of Z-drugs (e.g., zolpidem) over traditional benzodiazepines?
9. Explain the mechanism of action of phenytoin and its major long-term side effects.
10. Describe the broad-spectrum anticonvulsant mechanism of sodium valproate.
11. What is the drug of choice for the treatment of absence (petit mal) seizures, and what is its molecular mechanism?
12. Explain the pathophysiological basis of Parkinson's disease regarding the dopamine-acetylcholine balance.
13. Why is levodopa formulated with carbidopa or benserazide?
14. Explain the "on-off" phenomenon and "wearing-off" effect associated with long-term levodopa therapy.

15. Describe the mechanism of action of entacapone and selegiline in the treatment of Parkinson's disease.
16. Discuss the clinical indications and side effects of dopamine receptor agonists (e.g., pramipexole, bromocriptine).

Theme 8

Agents regulating mental activity (psychotropic agents). Psychostimulants. Antidepressants. Nootropics, adaptogens, actoprotectors. Analeptics.

Aim

To master the classification, mechanisms of action, and therapeutic applications of antipsychotics, antidepressants, psychostimulants, cognitive enhancers, and respiratory stimulants.

Control Questions

1. Explain the dopamine hypothesis of schizophrenia and how it relates to the mechanism of typical neuroleptics (antipsychotics).
2. Compare typical (e.g., chlorpromazine, haloperidol) and atypical (e.g., clozapine, olanzapine) antipsychotics regarding their receptor profiles and side effects.
3. What are extrapyramidal symptoms (EPS) and neuroleptic malignant syndrome (NMS), and how are they managed?
4. Describe the monoamine hypothesis of depression.
5. Classify antidepressants into TCAs, SSRIs, SNRIs, and MAOIs, providing clinical examples for each group.
6. Explain the mechanism of action and side effects (including anticholinergic and cardiotoxic effects) of amitriptyline.
7. Why are SSRIs (e.g., fluoxetine, sertraline) preferred over TCAs in modern clinical practice?
8. What is "serotonin syndrome," what are its symptoms, and which drug combinations trigger it?
9. Explain the "cheese reaction" (hypertensive crisis) associated with monoamine oxidase inhibitors (MAOIs).
10. Describe the clinical uses and toxic side effects of lithium carbonate in bipolar disorder.
11. What is the mechanism of action and clinical indications of psychostimulants like methylphenidate?
12. Define "nootropics" and explain how piracetam is thought to improve cognitive function.
13. What are "adaptogens" (e.g., Ginseng, Eleutherococcus) and what is their proposed physiological effect?
14. Define "actoprotectors" (e.g., bemithyl) and discuss their application in enhancing physical endurance.
15. Classify analeptics and explain their mechanism of action on the respiratory and vasomotor centres of the brainstem.
16. Compare the abuse potential and physical dependence profiles of psychostimulants vs. nootropics.
17. Explain the mechanism of action and indications of atomoxetine in ADHD.
18. Discuss the role of mirtazapine as an atypical antidepressant (noradrenergic and specific serotonergic antidepressant - NaSSA).

Theme 9

Antihypertensive and hypertensive agents. Cardiotonics. Cardiac glycosides. Antiarrhythmic agents.

Aim

To study the pharmacotherapy of hypertension, hypotension, congestive heart failure, and cardiac arrhythmias, focusing on the mechanisms of action and safety profiles of cardiovascular drugs.

Control Questions

1. Classify antihypertensive agents into major therapeutic classes and list their primary sites of action.
2. Explain the renin-angiotensin-aldosterone system (RAAS) and the mechanism of action of ACE inhibitors (e.g., enalapril) and ARBs (e.g., losartan).
3. Why do ACE inhibitors cause a dry cough in some patients, and what is the alternative therapy?
4. Compare the clinical indications and vascular selectivities of dihydropyridine (e.g., amlodipine) and non-dihydropyridine (e.g., verapamil) calcium channel blockers.
5. Explain the mechanism of action of centrally acting antihypertensive drugs (e.g., clonidine, methyldopa).
6. Classify positive inotropic agents used in the treatment of heart failure.
7. Describe the molecular mechanism of cardiac glycosides (e.g., digoxin) on the Na^+/K^+ -ATPase pump.
8. What are the hallmark symptoms of digoxin toxicity, and how do hypokalaemia and hypercalcaemia affect its severity?
9. Classify antiarrhythmic drugs according to the Vaughan Williams classification system, providing one drug example for each class.
10. Explain the electrophysiological mechanism of Class I antiarrhythmic drugs (sodium channel blockers) and the subclassification into Ia, Ib, and Ic.
11. Why is amiodarone (Class III) considered a broad-spectrum antiarrhythmic, and what are its long-term extra-cardiac toxicities?
12. Describe the mechanism of action and clinical use of adenosine in paroxysmal supraventricular tachycardia (PSVT).
13. What is the clinical role of beta-blockers in reducing mortality in patients with chronic heart failure?
14. Classify hypertensive agents used in emergency medicine for cardiogenic or anaphylactic shock.
15. Explain the pharmacodynamic differences between dobutamine and dopamine in cardiac care.

Theme 10

Hypolipidaemic and endotheliotropic agents. Antianginal and anti-ischaemic agents.

Aim

To analyze the pharmacotherapy of atherosclerosis, ischaemic heart disease, and coronary artery disease, evaluating lipid-lowering, antianginal, and cytoprotective drugs.

Control Questions

1. Explain the mechanism of action of statins (HMG-CoA reductase inhibitors) and their pleiotropic effects.
2. Compare the lipid-lowering profiles (LDL, HDL, Triglycerides) of statins, fibrates, and ezetimibe.
3. What is statin-induced myopathy (rhabdomyolysis), and what laboratory marker must be monitored?
4. Explain the mechanism of action and clinical administration of PCSK9 inhibitors (e.g., evolocumab).
5. Classify antianginal drugs based on their ability to decrease myocardial oxygen demand or increase myocardial oxygen supply.
6. Describe the molecular mechanism of organic nitrates (e.g., nitroglycerin) in venodilation and the reduction of preload.
7. Explain why nitrate tolerance develops and how to implement a "nitrate-free interval" in patient care.
8. Compare the haemodynamic effects of beta-blockers and organic nitrates in the management of stable angina.
9. Why are non-selective beta-blockers strictly contraindicated in patients with vasospastic (Prinzmetal's) angina?
10. Describe the unique anti-ischaemic mechanism of action of ranolazine.
11. What are "endotheliotropic" agents, and what is their role in protecting the vascular endothelium?
12. Explain how trimetazidine acts as a metabolic anti-ischaemic agent in myocardial cells.
13. Discuss the clinical role of low-dose aspirin and clopidogrel in the prevention of acute coronary syndromes.

Theme 11

Drugs affecting respiratory system function. Diuretics.

Aim

To evaluate the pharmacology of bronchodilators, anti-inflammatory agents for asthma and COPD, mucolytics, antitussives, and renal diuretic agents.

Control Questions

1. Classify bronchodilators used in the management of bronchial asthma and COPD.
2. Explain the molecular mechanism of selective β_2 -adrenergic agonists (SABA and LABA) on bronchial smooth muscle.
3. Describe the mechanism of action of inhaled corticosteroids (ICS) and their role as controller therapy in asthma.
4. Compare the pharmacological properties of ipratropium bromide (SAMA) and tiotropium bromide (LAMA).
5. Explain the mechanism of action and clinical indications of methylxanthines (e.g., theophylline).
6. What is the mechanism of action of leukotriene receptor antagonists (e.g., montelukast)?
7. Classify antitussive drugs into central (opioid and non-opioid) and peripheral groups, giving examples.
8. Describe the mechanisms of action of mucolytic agents (e.g., acetylcysteine, ambroxol).
9. Classify diuretic agents based on their primary site of action along the nephron.

10. Explain the mechanism of action of loop diuretics (e.g., furosemide) on the $Na^+/K^+/2Cl^-$ cotransporter in the thick ascending limb.
11. Why do loop and thiazide diuretics cause hypokalaemia, and what is the mechanism of potassium-sparing diuretics (e.g., spironolactone, triamterene)?
12. Explain the mechanism of action, indications, and ocular uses of carbonic anhydrase inhibitors (e.g., acetazolamide).
13. Describe the clinical indications and major side effects of thiazide diuretics (e.g., hydrochlorothiazide).
14. What are the indications and contraindications for the use of osmotic diuretics (e.g., mannitol)?

Theme 12

Agents affecting myometrial tone and activity.

Aim

To explore the pharmacology of uterine stimulants (oxytocics) and uterine relaxants (tocolytics), mastering their mechanisms of action, clinical indications, and maternal-fetal safety profiles.

Control Questions

1. Describe the physiological role of oxytocin and its receptor-mediated mechanism in initiating uterine contractions.
2. What are the primary clinical indications and absolute contraindications for the administration of oxytocin?
3. Explain the mechanism of action of ergot alkaloids (e.g., methylergometrine) and why they are restricted to postpartum use.
4. Describe the clinical uses of prostaglandins (PGE_2 like dinoprostone, and PGE_1 like misoprostol) in obstetrics.
5. What are the major maternal and fetal risks associated with oxytocin-induced uterine hyperstimulation?
6. Classify tocolytic agents used to suppress premature labor.
7. Explain the mechanism of action and side effects of β_2 -adrenoceptor agonists (e.g., hexoprenaline) when used as tocolytics.
8. How do calcium channel blockers (e.g., nifedipine) act as tocolytics, and what are their clinical advantages?
9. Explain the use of magnesium sulfate in obstetrics, including its mechanism as a tocolytic and its neuroprotective role in pre-eclampsia.
10. What is the mechanism of action of atosiban (oxytocin receptor antagonist) as a selective tocolytic?
11. Why are NSAIDs (e.g., indomethacin) used as tocolytics, and what are their potential risks to the fetus (e.g., ductus arteriosus)?

Theme 13

Agents influencing platelet aggregation, coagulation and fibrinolysis. Agents regulating haematopoiesis. Vitamin preparations. Coenzymes. Membrane stabilisers, antihypoxants, radioprotectors.

Aim

To master the pharmacology of drugs regulating haemostasis and haematopoiesis, as well as the therapeutic uses of vitamins, coenzymes, cytoprotective agents, antihypoxants, and radioprotectors.

Control Questions

1. Classify antiplatelet drugs based on their molecular targets (COX-1, $P2Y_{12}$ ADP receptors, and GP IIb/IIIa receptors).
2. Explain the mechanism of irreversible inhibition of cyclooxygenase-1 (COX-1) by low-dose acetylsalicylic acid.
3. Compare the mechanisms of action, administration routes, and monitoring requirements of unfractionated heparin (UFH) and low-molecular-weight heparins (LMWH).
4. What is the mechanism of action of oral anticoagulants (warfarin vs. direct oral anticoagulants like rivaroxaban and dabigatran)?
5. Explain the molecular mechanism of heparin reversal using protamine sulfate.
6. How do fibrinolytic (thrombolytic) agents (e.g., alteplase, streptokinase) dissolve thrombi, and what are their major contraindications?
7. Describe the clinical management of iron-deficiency anaemia using oral and parenteral iron preparations.
8. Explain the clinical indications and side effects of recombinant erythropoietin and granulocyte colony-stimulating factor (G-CSF).
9. Compare the physiological roles, deficiency syndromes, and therapeutic uses of Vitamin B_{12} and folic acid.
10. Classify vitamins into fat-soluble and water-soluble groups, and discuss the clinical consequences of hypervitaminosis A and D.
11. What is the role of Vitamin K in the coagulation cascade, and how is it used clinically as an antidote?
12. Define "coenzymes" and explain their therapeutic use (e.g., cocarboxylase, pyridoxal phosphate).
13. What are "membrane stabilisers" and how do they protect cellular integrity during pathological states?
14. Explain the concept of "antihypoxants" (e.g., ethylmethylhydroxypyridine succinate) and their mechanism of action under ischaemic conditions.
15. What are "radioprotectors" (e.g., amifostine) and how do they selectively protect healthy tissues during radiotherapy?
16. Describe the mechanism of action of antifibrinolytic drugs (e.g., tranexamic acid, aminocaproic acid).
17. What is Heparin-Induced Thrombocytopenia (HIT), and what alternative anticoagulants are indicated?

Theme 14

Hypothalamic, pituitary and pineal hormones. Thyroid, parathyroid and pancreatic hormone preparations.

Aim

To study the endocrine pharmacology of hypothalamic, pituitary, pineal, thyroid, parathyroid, and pancreatic hormone preparations, their synthetic analogues, and antagonists.

Control Questions

1. Classify hypothalamic and anterior pituitary hormones, listing their synthetic analogues and clinical indications.
2. Explain the clinical uses and side effects of somatropin (growth hormone) and octreotide (somatostatin analogue).

3. Describe the mechanism of action, clinical indications, and routes of administration of desmopressin (vasopressin analogue).
4. What is the physiological role of melatonin and its application in circadian rhythm disorders?
5. Describe the biosynthesis of thyroid hormones and the mechanism of action of levothyroxine in hypothyroidism.
6. Classify antithyroid (thyrostatic) drugs and explain the mechanisms of thioamides (e.g., thiamazole, propylthiouracil).
7. Discuss the major side effects of thioamides, focusing on agranulocytosis and hepatotoxicity.
8. Explain the endocrine regulation of calcium homeostasis by parathyroid hormone (PTH), calcitonin, and Vitamin D.
9. Describe the mechanism of action and clinical guidelines for administering bisphosphonates (e.g., alendronate) in osteoporosis.
10. Classify insulin preparations based on their pharmacokinetics (rapid-acting, short-acting, intermediate-acting, and long-acting).
11. Explain the mechanism of action of sulfonylureas (e.g., glibenclamide) on pancreatic β -cells.
12. What is the mechanism of action of metformin (biguanide) and why is it not associated with clinical hypoglycaemia?
13. Describe the pharmacology, renal effects, and cardiovascular benefits of SGLT2 inhibitors (e.g., dapagliflozin).
14. Compare the mechanisms of GLP-1 receptor agonists (e.g., liraglutide) and DPP-4 inhibitors (e.g., sitagliptin).
15. Describe the emergency management of severe hypoglycaemia (use of glucagon and concentrated dextrose).

Theme 15

Adrenal hormones, sex hormones. Anabolic steroids. Antihormonal agents. Modern contraceptives.

Aim

To master the pharmacology of corticosteroids, male and female sex hormones, anabolic steroids, synthetic contraceptives, and hormone antagonists.

Control Questions

1. Classify adrenal corticosteroids into glucocorticoids and mineralocorticoids, providing clinical examples.
2. Explain the genomic and non-genomic molecular mechanisms of action of glucocorticoids.
3. Describe the metabolic, immunological, and musculoskeletal side effects of chronic glucocorticoid therapy.
4. Why is the abrupt withdrawal of long-term glucocorticoid therapy dangerous, and how is it managed?
5. Classify estrogen and progesterone preparations and list their primary therapeutic indications.
6. Explain the mechanism of action of combined oral contraceptives (COCs) in suppressing ovulation.

7. Compare the side effects, metabolic risks, and contraindications of combined COCs vs. progestin-only pills (POPs).
8. What are "Selective Estrogen Receptor Modulators" (SERMs, e.g., tamoxifen, raloxifene) and what are their clinical indications?
9. Explain the mechanism of action and clinical uses of mifepristone as an antiprogesterin.
10. Describe the pharmacological properties of androgens and their synthetic anabolic steroid derivatives.
11. What are the clinical and psychological hazards associated with the abuse of anabolic steroids?
12. Explain the mechanism of action of 5 α -reductase inhibitors (e.g., finasteride) and androgen receptor antagonists (e.g., flutamide) in prostate disorders.
13. Describe the mechanism of action of aromatase inhibitors (e.g., anastrozole) in the treatment of breast cancer.
14. Discuss the pharmacology of gonadotropin-releasing hormone (GnRH) analogues (e.g., goserelin) in oncology.
15. Explain the mechanism of action and administration timeline for emergency contraception (e.g., levonorgestrel, ulipristal acetate).
16. Describe the clinical use of mineralocorticoid receptor antagonists (e.g., spironolactone) in hyperaldosteronism.

Theme 16

Agents modulating immune processes.

Aim

To study the pharmacology, mechanisms of action, clinical indications, and side effects of immunosuppressants, immunostimulants, and immunomodulatory biologic agents.

Control Questions

1. Classify immunomodulatory drugs into immunosuppressants and immunostimulants, providing examples.
2. Explain the molecular mechanism of action of calcineurin inhibitors (cyclosporine and tacrolimus).
3. Describe the classic side effect profiles of cyclosporine (including nephrotoxicity, neurotoxicity, and gingival hyperplasia).
4. Explain the mechanism of action of cytostatic immunosuppressants (e.g., azathioprine, methotrexate, mycophenolate mofetil).
5. What are biologic response modifiers, and how do anti-TNF- α monoclonal antibodies (e.g., infliximab, adalimumab) exert their therapeutic effect?
6. Why must patients be screened for latent tuberculosis before initiating anti-TNF therapy?
7. Describe the mechanism of action and clinical indications of mTOR inhibitors (e.g., sirolimus).
8. Classify immunostimulants based on their origin (bacterial, synthetic, cytokine-derived).
9. Explain the clinical uses and side effects of recombinant interferons (α , β , γ).
10. Describe the pharmacological concept of "immune checkpoint inhibitors" (e.g., pembrolizumab) in modern cancer immunotherapy.
11. What is the difference between active and passive immunization from a pharmacological perspective?

12. Discuss the use of intravenous immunoglobulin (IVIG) therapy as an immunomodulatory agent.

Theme 17

Antimicrobial and antiparasitic agents. Principal classes of chemotherapeutic and chemoprophylactic agents for infectious diseases. Antiseptics and disinfectants. Antibiotics.

Aim

To analyze the classification, mechanisms of action, resistance patterns, and toxicities of antiseptics, disinfectants, and major classes of antibacterial and antiparasitic drugs.

Control Questions

1. Define and distinguish between antiseptics, disinfectants, and chemotherapeutic agents.
2. Classify antiseptics based on their chemical structure, giving examples of halogen-containing, oxidising, and heavy metal agents.
3. Explain the mechanism of action of chlorhexidine and quaternary ammonium compounds.
4. Classify antibiotics according to their mechanism of action (cell wall, protein, and nucleic acid synthesis inhibitors).
5. Describe the mechanism of action of β -lactam antibiotics (penicillins, cephalosporins, carbapenems, monobactams).
6. How do bacterial β -lactamases cause resistance, and how do β -lactamase inhibitors (e.g., clavulanic acid, tazobactam) overcome this?
7. Compare the antimicrobial spectra and clinical indications of first- through fifth-generation cephalosporins.
8. Explain the mechanism of action and specific toxicities (ototoxicity, nephrotoxicity, neuromuscular blockade) of aminoglycosides.
9. What is the mechanism of action of tetracyclines, and why are they contraindicated in pediatric patients and pregnant women?
10. Describe the mechanism of action, clinical indications, and side effects (including QT prolongation) of macrolides (e.g., azithromycin).
11. Explain the mechanism of action of lincosamides (clindamycin) and their strong association with *Clostridioides difficile*-associated pseudomembranous colitis.
12. What is the mechanism of action of vancomycin (glycopeptide), and what is the pathophysiology of "red man syndrome"?
13. Differentiate between bactericidal and bacteriostatic antibiotics, explaining why combining them can sometimes be antagonistic.
14. Describe the mechanism of action of chloramphenicol and the pathophysiology of "gray baby syndrome" and aplastic anaemia.
15. What are the drug of choice and alternative treatments for Methicillin-Resistant *Staphylococcus aureus* (MRSA)?
16. Explain the clinical indications and systemic toxicities of polymyxins (e.g., colistin).
17. Define the "post-antibiotic effect" (PAE) and explain how it influences the dosing frequency of aminoglycosides.

18. Discuss the primary mechanisms of bacterial resistance to antibiotics (efflux pumps, target modification, enzymatic inactivation).

Theme 18

Sulfonamides, nitrofurantoin derivatives, 8-oxyquinoline, fluoroquinolones and other compounds. Antitubercular and antisyphilitic agents. Agents for prevention and treatment of protozoal infections.

Aim

To study the pharmacology, mechanisms of action, and toxicities of synthetic antimicrobials, anti-mycobacterial drugs, antisyphilitic regimens, and antiprotozoal agents.

Control Questions

1. Explain the mechanism of action of sulfonamides (structural antagonism of PABA) in folate synthesis.
2. Describe the synergistic mechanism of action of co-trimoxazole (sulfamethoxazole + trimethoprim).
3. Classify fluoroquinolones into generations and describe their mechanism of action (inhibition of DNA gyrase and topoisomerase IV).
4. What are the major side effects and warnings associated with fluoroquinolones (tendon rupture, QT prolongation, dysglycaemia)?
5. Describe the mechanism of action and clinical uses of nitrofurantoin in urinary tract infections.
6. Explain the clinical use and antimicrobial spectrum of 8-hydroxyquinoline derivatives (e.g., nitroxoline).
7. Classify antitubercular drugs into first-line and second-line agents.
8. Explain the mechanism of action and specific side effects (hepatotoxicity, peripheral neuropathy) of isoniazid, including the role of pyridoxine (B_6) co-administration.
9. Describe the mechanism of action and side effects of rifampicin, including its role as a potent hepatic enzyme inducer.
10. What is the mechanism of action of ethambutol, and what specific sensory toxicity must be monitored during its use?
11. Discuss the standard pharmacotherapy for syphilis, including the drug of choice for its different stages.
12. Classify antiprotozoal agents and describe the mechanism of action and clinical indications of metronidazole.
13. Explain the mechanism of action and side effects of chloroquine and artemisinin-based combination therapies (ACT) in malaria.
14. What are the primary pharmacological strategies for treating multi-drug-resistant tuberculosis (MDR-TB)?

Theme 19

Antiviral agents. Antifungal agents. Anthelmintics. Antineoplastic agents.

Aim

To master the classification, mechanisms of action, clinical indications, and toxicological profiles of antiviral, antifungal, anthelmintic, and antineoplastic (chemotherapeutic) drugs.

Control Questions

1. Classify antiviral drugs based on their clinical indications (anti-herpes, anti-influenza, anti-retroviral, anti-hepatitis).
2. Explain the selective mechanism of action of acyclovir (activation by viral thymidine kinase).
3. Describe the mechanism of action and administration timing of neuraminidase inhibitors (e.g., oseltamivir) in influenza.
4. Classify antiretroviral drugs used in HIV management (NRTIs, NNRTIs, PIs, INSTIs, and entry inhibitors).
5. Classify antifungal drugs based on their mechanism of action and chemical structure (polyenes, azoles, allylamines, echinocandins).
6. Explain the mechanism of action of amphotericin B and the pathophysiology of its dose-limiting nephrotoxicity.
7. Describe the mechanism of action of azole antifungals (inhibition of 14α -demethylase) and their potential for drug-drug interactions.
8. Classify anthelmintic drugs and explain the mechanisms of action of mebendazole and albendazole.
9. What is the mechanism of action and clinical indication of praziquantel in trematode and cestode infections?
10. Classify antineoplastic (chemotherapeutic) agents into cell cycle-specific and cell cycle-non-specific groups.
11. Explain the mechanism of action of methotrexate and the pharmacological rationale for "leucovorin rescue" (folinic acid).
12. Describe the mechanism of action of cyclophosphamide (alkylating agent) and the role of mesna in preventing haemorrhagic cystitis.
13. Compare the mechanisms of microtubule-targeting drugs: Vinca alkaloids (e.g., vincristine) vs. Taxanes (e.g., paclitaxel).
14. What are the common dose-limiting toxicities of traditional chemotherapy (myelosuppression, cardiotoxicity of doxorubicin, nephrotoxicity of cisplatin)?
15. Explain the mechanism of action and clinical utility of targeted molecular therapies (e.g., imatinib as a tyrosine kinase inhibitor).

Theme 20

Key aspects of chronopharmacology. The role of chronopharmacology in improving efficacy and safety of medicinal products. Principles of treating acute poisoning. Plasma-substituting and detoxification agents.

Aim

To study the principles of chronopharmacology, the emergency management of acute drug poisonings (including antidotal therapy), and the pharmacology of plasma-substituting and detoxification solutions.

Control Questions

1. Define the terms "chronopharmacology", "chronokinetics", and "chronodynamics", explaining their clinical relevance.
2. Provide two clinical examples where drug efficacy or safety is significantly improved by timing administration with circadian rhythms (e.g., statins, glucocorticoids).

3. Explain the general principles of managing acute poisoning (supportive care, prevention of absorption, enhancement of elimination, specific antidotal therapy).
4. Describe the methods used to decrease gastrointestinal absorption of poisons (activated charcoal, gastric lavage, whole-bowel irrigation).
5. Explain the pharmacological basis and clinical indications of forced alkaline diuresis (e.g., in salicylate or phenobarbital poisoning).
6. What are chelating agents (e.g., deferoxamine, EDTA, penicillamine) and when are they indicated?
7. Match the following toxins/drugs with their specific antidotes: paracetamol, opioids, benzodiazepines, organophosphates, heparin, warfarin.
8. Classify plasma-substituting solutions into crystalloids and colloids, providing examples of each.
9. Compare the volume-expanding efficacy and haemodynamic effects of isotonic saline (0.9% NaCl) vs. dextran solutions.
10. What are the primary clinical risks associated with the rapid administration of high-molecular-weight colloid solutions?
11. Explain the mechanism of action and clinical indications of detoxifying solutions containing low-molecular-weight polyvinylpyrrolidone (hemodez) or balanced electrolytes.
12. Discuss how the chronotherapy of antihypertensive medications (morning vs. bed-time dosing) can affect the cardiovascular risk profile.
13. What is the pharmacological antidote for atropine poisoning, and what is its mechanism of action?

Educational, Methodological, and Informational Support for the Discipline

List of Main and Additional Literature Required for Mastering the Discipline (Module)

List of Main Literature:

1. Sokolov V.D. Pharmacology: textbook / V.D. Sokolov. 4th ed., rev. and enlarged. St Petersburg: Lan, 2022. 576 pp. ISBN 978-5-8114-0901-3. (Electronic text via Lan e-library: <https://e.lanbook.com/book/211262>)
2. Pharmacology: textbook / ed. R.N. Alyautdin. 6th ed., rev. and enlarged. Moscow: GEOTAR-Media, 2022. 1104 pp. ISBN 978-5-9704-6819-7. (Electronic text via Student Library e-resources: <https://www.studentlibrary.ru/book/ISBN9785970468197>)
3. Kharkevich D.A. Pharmacology: textbook / D.A. Kharkevich. 13th ed., rev. Moscow: GEOTAR-Media, 2022. 752 pp. ISBN 978-5-9704-6820-3. (Electronic text via Student Library: <https://www.studentlibrary.ru/book/ISBN9785970468203>)

List of Additional Literature:

1. Alyautdin R.N. Pharmacology: textbook / R.N. Alyautdin, N.G. Preferansky. Moscow: GEOTAR-Media, 2020. 688 pp. ISBN 978-5-9704-5598-2. (Electronic: Student Library)
2. Alyautdin R.N. Pharmacology: textbook / ed. R.N. Alyautdin. 4th ed., rev. and enlarged. 2008. 832 pp. ISBN 978-5-9704-0710-3. (Electronic: Student Library)
3. Andreeva N.L., Nozdrin G.A. Pharmacology / N.L. Andreeva, G.A. Nozdrin; ed. V.D. Sokolov. 5th ed. St Petersburg: Lan, 2022. 576 pp. ISBN 978-5-8114-9778-2. (Electronic: Lan e-library)
4. Vengerovsky A.I. Pharmacology: textbook. Moscow: GEOTAR-Media, 2022. 848 pp. ISBN 978-5-9704-6722-0. (Electronic: Student Library)

5. Pharmacology: practical manual for classes / R.N. Alyautdin, N.G. Preferansky; ed. R.N. Alyautdin. 3rd ed., rev. and enlarged. Moscow: GEOTAR-Media, 2022. 608 pp. ISBN 978-5-9704-7066-4. (Electronic: Student Library)
6. Fedukovich N.I. Pharmacology: textbook. Rostov-on-Don: Phoenix, 2022. ISBN 978-5-222-35174-1. (Electronic: Student Library)
7. Chabanova V.S. Pharmacology: textbook. 2nd ed. Minsk: Vyshheyshaya Shkola, 2021. 448 pp. ISBN 978-985-06-3319-4. (Electronic: Lan e-library)

List of Educational and Methodological Support for the Independent Work of Students in the Discipline (Module)

Anenko D.S. Methodological guidance on the course “Pharmacology” for students of the speciality 31.05.01 General Medicine [Electronic version], Stavropol: North-Caucasus Federal University (electronic version).

List of Resources of the Information and Telecommunications Network **Internet** Required for Mastering the Discipline (Module)

1. <http://rudocor.net/> – Medical portal
2. <http://www.e-reading.club/> – Large online library
3. <http://www.pubmed.com/> – database of biomedical full-text articles
4. <http://www.spravocnikpolekarstvam.ru/> – free online pharmacological reference
5. <https://dic.academic.ru/> – dictionaries and encyclopaedias
6. <https://www.rmj.ru/> – Russian Medical Journal
7. <https://www.studentlibrary.ru/> – Student Library e-resources