

Ministry of health of the Republic of Belarus

**Educational institution
«Gomel State Medical University»**

Department of general and clinical pharmacology

Authors:

N.V.Trofimova, CMS, Associate Professor

E.I. Mikhailova, head of department, DMS, prof.

A.Y. Braga, assistant

METHODOLOGICAL RECOMMENDATIONS

for a practical lesson on the discipline "Pharmacology"
for the third-year students of the Faculty of Foreign Students,
studying at the specialty 1-79 01 01 "General medicine"

TOPIC 25: «AGENTS REGULATING TISSUE METABOLISM. POLYPEPTIDE HORMONES AND ANTIHORMONAL AGENTS. STEROID HORMONES»

Time: 3 hours

Approved at the meeting of the department of general and clinical pharmacology
the protocol № 18 of 30.06.2022

LEARNING AND EDUCATIONAL GOALS, OBJECTIVES, MOTIVATION FOR LEARNING THE TOPIC

Hormones are biologically active substances produced by endocrine glands and special groups of cells. Hormones, secreting into the blood, have a regulatory effect on organs and tissues. Hormonal drugs are obtained synthetically, as well as from various biological materials (urine, animal organs, placenta, etc.). A significant number of compounds have been synthesized that act like natural hormones (their analogues and derivatives, as well as synthetic substitutes for a different chemical structure). Hormonal pills are widely used in clinical practice as a means of replacement therapy (for hypothyroidism, diabetes, etc.) and for insufficient function of the endocrine glands. In many cases, they are also used for other indications, taking into account the spectrum of their physiological action. For example, glucocorticoids are prescribed as anti-allergic, immunosuppressive and anti-inflammatory drugs. Hormones are agonists of specific receptors sensitive to them. Antagonists of a number of hormones have also been obtained, which can block specific receptors or prevent the synthesis of endogenous hormones. Clinicians note that without hormonal drugs, therapy would be half as poor, and therefore knowledge of these drugs is very significant for a highly professional doctor.

Steroid hormones are widely used for the purpose of replacement therapy for hypofunction of the adrenal cortex, male and female gonads, as well as for the pathology of internal organs, the nervous system, surgical, eye, skin and many other diseases. This is due to the fact that steroid hormones are involved in compensatory reactions in violation of not only the function of the endocrine glands, but also the functions of other organs. The first drugs from the group of glucocorticosteroids were cortisone and hydrocortisone isolated from the adrenal glands, which have anti-inflammatory, anti-allergic, immunosuppressive and other effects. A significant increase in the anti-inflammatory activity of steroids was achieved by introducing fluorine atoms into their molecule. Fluorinated synthetic analogues of corticosteroids (dexamethasone, triamcinolone, sinaflan, etc.) have powerful anti-inflammatory and antiallergic activity and are currently widely used in various fields of medicine. However, steroid hormones can cause a significant number of side effects and worsen the course of pathological processes, if the individual characteristics of the patient and the nature of the pathological process are not taken into account when choosing hormonal drugs and their dosage. Knowledge of the properties, features of the action and dosage of these drugs is necessary for a doctor of any specialty.

Learning objective:

- formation of scientific knowledge about the main pharmacological effects, providing therapeutic and preventive effect of drugs on the topic of the class, indications and contraindications for their use, the interaction of drugs, their combined use for use in medical and preventive activities.

Educational purpose:

- to develop their value-personal, spiritual potential, to form the qualities of a patriot and a citizen, ready for active participation in the economic, industrial, socio-cultural and public life of the country; to realize the social significance of their future professional activities, to learn to observe educational and labor discipline, the norms of medical ethics and deontology.

Tasks:

As a result of the study lesson, the student should

know:

- classification and basic characteristics of the studied drugs, pharmacodynamics and pharmacokinetics, indications and contraindications for their use, side effects;
- features of pharmacokinetics and pharmacodynamics, advantages and disadvantages of different dosage forms of these drugs;
- principles of research and testing of new drugs; information and reference and search systems;

be able to:

- analyze the effect of the studied drugs on the set of their pharmacological properties and the possibility of their use in medical practice; to write them in prescriptions;
- use different dosage forms of these drugs, based on the peculiarities of their pharmacodynamics and pharmacokinetics;
- work with scientific literature, search for information about the use and action of the studied drugs;

possess:

- skills in choice of drugs on the topic of the lesson;
- the rules of prescribing the studied drugs in the treatment of various diseases and pathological conditions, taking into account the indications;
- skills of dosage regime correction in case of pathological changes in functions of organs or systems responsible for biotransformation and elimination of drugs or in case of joint use of different drugs;
- skills to search, analyze and summarize information about the use and effects of the studied drugs.

Motivation for learning the topic:

- the specifics of training doctors in this specialty determines the need for students to purposefully study the main pharmacological effects, providing therapeutic and preventive effects of drugs on the topic of the class, indications and contraindications for their use, the interaction of drugs, their combined use, which will successfully complete the specialized disciplines of the specialty.

MATERIAL EQUIPMENT

Reference and informational literature, charts, tables, presentations, drug collections.

CONTROL QUESTIONS FROM RELATED DISCIPLINES

1. Anatomical and physiological features of the hypothalamic-pituitary system. Hormones produced by the hypothalamus and pituitary gland. Neurohumoral regulation of the functioning of the hypothalamic-pituitary system.
2. Anatomical and physiological features of the thyroid and parathyroid glands. Biosynthesis of thyroid hormones. The concept of endemic goiter.
3. Anatomical and physiological features of the pancreas. The concept of diabetes.
4. Biochemistry of the synthesis of corticosteroids, sex hormones. Endocrine diseases associated with dysfunction of the adrenal glands, gonads.
5. Pathophysiological basis of inflammation.
6. Types of allergic reactions.

CONTROL QUESTIONS ON THE TOPIC OF THE LESSON

1. Hormones, their synthetic analogues, substitutes and antagonists, sources of production, principles of biological standardization and dosing, classification.

2. Drugs of hypothalamic hormones: octreotide, gonadorelin, goserelin, protirelin. Influence of hypothalamic hormones on the secretion of hormones of the anterior pituitary gland, application in medicine.

3. Drugs of hormones of the anterior pituitary gland: somatropin, tetracosactide, gonadotropins (follitropin alpha and beta, urofollitropin, chorionic gonadotropin, lutropin alpha, menotropins), thyrotropin alpha. Influence of hormones of the anterior pituitary gland on the endocrine glands, use in medicine.

4. Antagonists of the anterior pituitary hormones: growth hormone receptor antagonist (pegvisomant), prolactin secretion inhibitor (bromocriptine), gonadotropic hormone release inhibitor (danazol).

5. . Drugs of hormones of the posterior lobe of the pituitary gland: oxytocin, terlipressin, desmopressin. The use of oxytocin preparations in obstetrics. Antidiuretic properties of vasopressin, effect on intestinal and vascular tone. The use of desmopressin and terlipressin.

6. Drugs of pineal gland hormones (melatonin): pharmacological activity, use in medicine.

7. Thyroid and antithyroid drugs. Thyroid drugs: levothyroxine sodium (T₄), liothyronine (T₃), their therapeutic use. Antithyroid drugs (thiamazole, propylthiouracil, iodides, radioactive iodine, β -blockers), mechanisms of action, use, side effects and complications.

8. Drugs of the hormone of the parathyroid glands (teriparatide), the effect on the exchange of phosphorus and calcium, use.

9. Pancreatic hormones and synthetic antidiabetic agents. Classification. Effect of insulin on metabolism. Drugs of short and long-acting insulin (soluble insulin, insulin isophane, insulin zinc crystalline suspension, insulin zinc combined suspension, biphasic insulin), sources of production. Principles of dosing and administration of insulin drugs, complications of insulin therapy. Oral hypoglycemic agents (glibenclamide, gliquidone, metformin), mechanism of action, indications for use, side effects. Other antidiabetic agents: increasing the sensitivity of tissues to insulin (pioglitazone), stimulating the release of insulin (repaglinide), inhibiting the absorption of carbohydrates from the intestine (acarbose), dipeptidyl peptidase-4 inhibitors (vildagliptin). Insulin antagonists (glucagon, epinephrine, glucocorticosteroids (GCS)), mechanisms of action, application.

10. Drugs of adrenal cortex hormones.

GCS: hydrocortisone, methylprednisolone, prednisolone, triamcinolone, dexamethasone, betamethasone, fluocinolone acetonide. Influence of GCS on metabolism in the body. Anti-inflammatory and anti-allergic properties of corticosteroids, therapeutic use, side effects. Synthetic corticosteroids for local use. Mineralocorticoids: deoxycortone, fludrocortisone. Biological action and application of mineralocorticoids. Corticosteroid synthesis inhibitors (aminoglutethimide).

11. Preparations of female sex hormones.

Estrogen drugs: estradiol, ethinyl estradiol, hexestrol, estrogen receptor modulators (raloxifene).

Progestin preparations: progesterone, dydrogesterone.

Chemical structure and physiological significance of estrogens and gestagens, therapeutic use.

Hormone replacement therapy for menopausal disorders.

Antagonists of estrogens and progestins (tamoxifen, mifepristone), use in medicine.

Contraceptives (contraceptives): monophasic ("Marvelon"), two-phase ("Anteoivin"), three-phase ("Tri-regol"), norethisterone, levonorgestrel; principles of action, side effects.

12. Preparations of male sex hormones, anabolic steroids.

Androgenic drugs (testosterone and its esters): pharmacological activity, use, side effects.

Antiandrogenic drugs (flutamide): use, side effects.

Anabolic steroids (nandrolone): the effect of anabolic steroids on metabolic processes, use, side effects.

13. Hormonal regulators of mineral homeostasis and other drugs that affect bone metabolism.

Parathyroid (teriparatide) and antiparathyroid (calcitonin, paricalcitol) agents; bisphosphonates (alendronic acid), vitamin D and analogues (alfacalcidol): mechanism of action, uses, side effects.

PROCESS OF THE STUDY

Theoretical part

Theoretical questions are described in the appendix to the methodological recommendations.

Practical part

1. Take notes on theoretical material demonstrated by the teacher.
2. Master the methods of solving the tasks and writing out prescriptions on the topic of the class.

Theme learning control

Conducted in the form of independent written work (solution of practical problems and prescriptions for individual task).

METHODOLOGICAL RECOMMENDATIONS FOR ORGANIZATION AND EXECUTION OF STUDENTS' INDEPENDENT WORK (SIW)

The time given for independent work can be used by students for:

- preparing for the practical classes;
- completing the tasks on the topic of the class in the workbook;
- preparing thematic reports, essays and presentations;
- taking notes from academic literature.

The main methods of organizing independent work:

- completing tests and practical tasks of the electronic educational-methodical complex (EEMC) for self-monitoring and self-assessment.

The list of tasks of the SIW:

- solving practical problems in the EEMC;
- completing the test tasks of the EEMC.

Control of the SIW is carried out in the form of:

- assessment of an oral answer to a question, report, report, or solution of a task in a practical class;
- individual conversation.

METHODOLOGICAL RECOMMENDATIONS FOR ORGANIZATION AND EXECUTION OF CONTROLLED INDEPENDENT WORK OF STUDENTS (CIWS)**Recommended forms of CIWS organization:**

- doing exercises on the topic of the class in the workbook;
- writing an essay on a given topic;
- preparing a report and a multimedia presentation on a given topic.

The list of tasks of the CIWS:

Topics of essays / multimedia presentations:

1. Phytotherapy in the treatment of diabetes mellitus.
2. Combined oral contraceptives.
3. Male contraception, a modern trend.
4. Antihormonal agents in modern practical medicine.
5. Anabolic steroids in sports - pro et contra.

Forms of control of CIWS realization:

- checking and grading an essay on a given topic;
- checking and grading a multimedia presentation on a given topic.

LIST OF REFERENCES

1. Kharkevitch, D.A. Pharmacology: textbook for med. students: transl. of 12th ed. of Russ. textbook "Pharmacology" (2017) / D.A. Kharkevitch. - 2nd ed. - Москва: ГЭОТАР-Медиа, 2019. - 676 с.: ил., табл. - Рек. ФГАУ "ФИРО". – Режим доступа: <http://www.studmedlib.ru/book/ISBN5970402648.html> – Дата доступа: 23.05.2022.

2. Конорев, М. Р. Курс лекций по фармакологии. В 2 т. Т. 2, ч. 1 : для студентов 3 и 4 курсов фармацевт. фак. учреждений высш. образования, обучающихся по специальности 1 - 79 01 08 "Фармация" / М. Р. Конорев, И. И. Крапивко, Д. А. Рождественский ; УО "ВГМУ", Каф. общей и клинической фармакологии с курсом ФПКипк. - Витебск: ВГМУ, 2019. - 294 с.: ил., табл. - Рек. УМО по высш. мед., фармацевт. образованию.

3. Конорев, М. Р. Курс лекций по фармакологии. В 2 т. Т. 2, ч. 2 : для студентов 3 и 4 курсов фармацевт. фак. учреждений высш. образования, обучающихся по специальности 1 - 79 01 08 "Фармация" / М. Р. Конорев, И. И. Крапивко, Д. А. Рождественский ; УО "ВГМУ", Каф. общей и клинической фармакологии с курсом ФПКипк. - Витебск: ВГМУ, 2019. - 165 с.: ил. - Рек. УМО по высш. мед., фармацевт. образованию.

4. Кратко о лекарственных средствах: учебно – методическое пособие для студентов 3 и 6 курсов факультета иностранных студентов, учреждений высшего мед. образования: в 2 ч.=Drugs in short: partical workbook for 3 and 6 year students Faculty for International Students of medical higher educational institutions: in 2 parts / Е.И. Михайлова [и др.]. – Ч. 1. – Гомель: ГомГМУ, 2020. – 56с. – Режим доступа: <http://elib.gsmu.by/xmlui/handle/GomSMU/7128> – Дата доступа: 23.05.2022.

5. Кратко о лекарственных средствах: учебно – методическое пособие для студентов 3 и 6 курсов факультета иностранных студентов, учреждений высшего мед. образования: в 2 ч.=Drugs in short: partical workbook for 3 and 6 year students Faculty for International Students of medical higher educational institutions: in 2 parts / Е.И. Михайлова [и др.]. – Ч. 2. – Гомель: ГомГМУ, 2020. – 76с. – Режим доступа: <http://elib.gsmu.by/xmlui/handle/GomSMU/7129> – Дата доступа: 23.05.2022.

Hypothalamic and pituitary hormone

Classification	Hypothalamic hormones		Pituitary hormones	
Drugs	Releasing hormones 1. Thyrotropin-releasing hormone (protirelin) 2. Gonadotropin-releasing hormone GnRH (gonadorelin and synthetic analogues: goserelin, leuprolide, nafarelin, buserelin, gistrelin) 3. Growth hormone-releasing hormone (somatorelin) 4. Corticoliberin	Hormone secretion inhibitors 5. Somatostatin (octreotide) 6. Gonadotropin-releasing hormone antagonists (cetorelix, ganirelix) 7. Antigonadotropins (androgen danazol)	Anterior lobe 8. Somatotropin 9. Thyrotropin (thyrogen) 10. Adrenocorticotrophic hormone ACTH (cosyntropine) 11. Follicle-stimulating hormone FSH (urofolllotropin) 12. Luteinizing hormone LH (human chorionic gonadotropin: pregnil)	Posterior lobe 13. Oxytocin <i>Analogues of vasopressin:</i> 14. Desmopressin 15. Terlipressin
Mechanism of action	Interact with membrane receptors and change protein synthesis in the cells			
Pharmacological effects	1. Release of TSH and prolactin (1) 2. Release of LH and FSH (with constant admission - suppression) antitumor, antiandrogenic effect (2) 3. Release of somatotropin (3) 4. Release of ACTH (4)	1. Suppression of excretion of somatotropin, glucagon, insulin, serotonin, gastrin (5) 2. Suppression of LH and FSH release (6) 3. Suppression of GnRH, FSH and LH release, proliferation of lymphocytes (7)	1. Anabolic, growth stimulation (8) 2. Release of thyroid hormones (9) 3. Release of hormones of the adrenal cortex (10) 4. Stimulates folliculogenesis in women and spermatogenesis in men (11) 5. Stimulation of ovulation and estrogen secretion (12)	1. ↑ tonus and contractile activity of the uterus, stimulation of lactation (13) 2. Antidiuretic effect. ↑ Tone smooth muscle (14) 3. Vasopressor, hemostatic (↑ activity of VIII factor of blood coagulation) (15)
Indications	1. Diagnosis of hypothyroidism, hypo- and agalactia in women (1) 2. Hormone-dependent prostate cancer, endometriosis, uterine fibroids, preparation for superovulation in IVF (constant intake). Infertility (pulse reception) (2) 3. Diagnosis of pituitary nanism in children (3) 4. Diffiagnosis of Cushing's disease and secretion of ACTH by ectopic foci of the tumor (4)	1. Acromegaly, endocrine tumors of the gastroentero-pancreatic system, bleeding from varicose veins of the esophagus in cirrhosis of the liver, refractory diarrhea in AIDS patients (5) 2. In vitro fertilization, endometriosis, fibromatosis (6) 3. Endometriosis with concomitant infertility, benign neoplasms of the breast, PMS, gynecomastia; Hereditary angioedema (7)	1. Violation of growth processes in children (8) 2. In combination with the radioactive isotope of iodine - for visualization of metastases of thyroid gland cancer and its residues after thyroidectomy (9) 3. Evaluation of the function of the adrenal glands cortex (10) 4. Polycystic ovarian syndrome, infertility of ovarian genesis (11) 5. In women: anovulatory infertility. In men: pituitary hypogonadism, cryptorchidism, delayed puberty (12)	1. Stimulation of labor, hypotonic uterine bleeding, hypolactia (13) 2. Diabetes insipidus, polyuria and polydipsia after pituitary operations, haemophilia A, von Willebrand's disease (14) 3. Gastrointestinal and genito-urinary bleeding (15)

Side effects	1. Fluctuations of blood pressure (1) 2. Headache, mood and libido changes, gastrointestinal disturbances (2) 3. Pain at the injection site, headache (3) 4. Redness of the face (4)	1. Nausea, vomiting, diarrhea (5) 2. Ovarian hyperstimulation syndrome (6) 3. Hirsutism, acne, menstrual irregularities, mood changes, hepatotoxicity (7)	1. Hypothyroidism, headache, nausea (8) 2. Nausea, headache, sensation of cold (9) 3. Infiltrates at the injection site; See glucocorticoids (10) 4. Dyspeptic disorders, lung atelectasis, respiratory distress, non-cardiogenic pulmonary edema, ovarian hyperstimulation syndrome, thromboembolic complications (11) 5. Headache, depression, edema, premature puberty, gynecomastia (12)	1. Nausea, vomiting, arrhythmia and bradycardia (including the fetus), ↑ AD, bronchospasm (13) 2. Nausea, abdominal pain, tachycardia (14) 3. Hypertension, bradycardia, difficulty breathing (15)
Contraindications	1. Organic CNS damage, epilepsy (1) 2. Age under 14 years (2) 3. Pregnancy, lactation (3) 4. Heart failure (4)	1. Hypersensitivity (5) 2. Pregnancy, lactation, postmenopause (6) 3. Androgen-dependent tumors, breast cancer, thromboembolism, genital bleeding, pregnancy, lactation (7)	1. Malignant neoplasms, pregnancy (8) 2. Pregnancy, lactation (9) 3. See glucocorticosteroids (10) 4. High level of FSH in primary ovarian failure, decompensated thyroid and adrenal pathology, pituitary tumors (11) 5. Bronchial asthma, epilepsy, hormone-sensitive tumors of genital organs (12)	1. Narrow pelvis, premature birth, threatening uterine rupture, uterus after multiple births, AH (13) 2. Polydipsia, anuria, unstable angina (14) 3. Anuria, epilepsy, pregnancy (15)

Thyroid and antithyroid drugs

Thyroid drugs - preparations of thyroid hormones (TG).

Antithyroid drugs - drugs that exert a retarding effect on the biosynthesis of thyroid hormones.

Classification	Thyroid drugs		Antithyroid drugs
Drugs	<i>T4 drugs</i>	<i>T3 drugs</i>	4. Thiamazole (Mercazolil, tyrosol) 5. Propylthiouracil
	1. L-thyroxine (eutiroks, levothyroxine) 2. Iodothyrox (levothyroxine sodium + potassium iodide)	3. Lyotyronin	
Mechanism of action	Receptor binding to the genome, a change in oxidative metabolism in the mitochondria		Thyroid peroxidase is blocked and iodination of thyronine in T4 in T3 is inhibited.
Pharmacological effect	In small doses - anabolic, in moderate - ↑ activity of the cardiovascular system and tissues oxygen demand, in big - oppression of thyrotropin-releasing hormone and thyroid-stimulating hormone.		↓ T3 and T4 levels in the blood
Indications for use	1. Hypothyroidism 2. Euthyroid goiter 3. Autoimmune thyroiditis 4. Substitution therapy after surgical treatment of thyroid cancer 5. Myxedema (3) 6. Cretynism (3) 7. Hypothyroid obesity		1. Thyrotoxicosis 2. Preparation for resection of thyroid gland or treatment 3. Postoperative relapse of thyrotoxicosis (4) 4. Nodular goiter (4)

Side effects	<ol style="list-style-type: none"> 1. Arrhythmia 2. Tachycardia 3. Angina pectoris 4. ↑ temperature 5. Anxiety, insomnia 	<ol style="list-style-type: none"> 1. Arthralgia 2. Allergic reactions 3. Suppression of myelopoiesis 4. Dysfunction of the liver 5. Vasculitis 6. Hypothyroidism
Contraindications	<ol style="list-style-type: none"> 1. Uncompensated pituitary or adrenal insufficiency 2. Thyrotoxicosis 3. Acute myocardial infarction 4. Myocarditis 5. Pancarditis 6. Cachexia (3) 	<ol style="list-style-type: none"> 1. Hypersensitivity 2. Leukopenia, agranulocytosis 3. Hypothyroidism 4. Hepatic insufficiency 5. Cirrhosis of the liver 6. Active hepatitis 7. Cholestasis (4) 8. Pregnancy, lactation

Parathyroid and antiparathyroid drugs

Parathyroid drugs - drugs that make up the deficit of parathyroid (PTG) hormones.

Antiparathyroid drugs - drugs that exert a retarding effect on the biosynthesis of PTG hormones.

Classification	Parathyroid drugs	Antiparathyroid drugs
Drugs	<ol style="list-style-type: none"> 1. Calcitonin (myacalcin, fortical) 2. Parathyroid hormone (natpara) 	<ol style="list-style-type: none"> 3. Cinacalcet (sensipar, mimpara)
Mechanism of action	<ol style="list-style-type: none"> 1. Inhibits the activity of osteoclasts, promotes bone mineralization due to the transition of Ca^{2+} from the blood to the bone (1) 2. ↑ absorption of Ca^{2+} in the intestine, promotes the release of Ca^{2+} from bones (2) 	Calcium-mimetic action - ↑ sensitivity of PTG receptors to calcium
Pharmacological effect	<ol style="list-style-type: none"> 1. Hypocalcemic, inhibition of bone resorption, analgesic (1) 2. Hypercalcemic, increased bone resorption, stimulation of the formation of vit. D3 (2) 	Hypocalcemic, ↓ level of parathyroid hormone
Indications for use	<ol style="list-style-type: none"> 1. Prevention of osteoporosis, Paget's disease of bone (osteitis deformans), hypercalcemia, algodystrophy (1) 2. Tetania, spasmodophilia, bronchial asthma, urticaria, vasomotor rhinitis, hay fever, other allergic conditions (2) 	<ol style="list-style-type: none"> 1. Secondary hyperparathyroidism in dialysis patients with chronic renal failure 2. Hypercalcemia from pancreatic carcinoma 3. Primary hyperparathyroidism in the absence of parathyroidectomy
Side effects	<ol style="list-style-type: none"> 1. Nausea, vomiting, dizziness, flush of the face accompanied by a sense of heat (1) 2. General weakness, lethargy, vomiting and diarrhea, bone resorption and hyperplasia of fibrous tissue (2) 	<ol style="list-style-type: none"> 1. Secondary hyperparathyroidism in dialysis patients with chronic renal failure 2. Hypercalcemia from pancreatic carcinoma 3. Primary hyperparathyroidism in the absence of parathyroidectomy
Contraindications	<ol style="list-style-type: none"> 1. Hypersensitivity, hypocalcemia (1) 2. Hypersensitivity, previous hypercalcemia, severe renal failure, bone metastases or bone tumors in anamnesis, pregnancy, lactation (2) 	<ol style="list-style-type: none"> 1. Hypocalcemia 2. Anorexia 3. Dizziness 4. Nausea, vomiting 5. Rash, myalgia 6. Asthenia

Insulins and synthetic hypoglycemic agents

Hypoglycemic agents are drugs used to normalize blood glucose levels in diabetes mellitus.

Classification	Insulins	Oral hypoglycemic agents
Drugs	<p><i>Short-acting drugs</i></p> <ol style="list-style-type: none"> 1. Actrapid 2. Belrapid 3. Novorapid 4. Monoinsulin MK 5. Humalog 6. Apidra <p><i>Medium-acting drugs</i></p> <ol style="list-style-type: none"> 7. Humulin NPH 8. Protaphan 9. Protamine insulin 10. Insulin-long 11. Insulin Semilong <p><i>Long-acting drugs</i></p> <ol style="list-style-type: none"> 12. Lantus 13. Levemir 	<p><i>Biguanides</i></p> <ol style="list-style-type: none"> 14. Metformin <p><i>Sulfonylurea derivatives</i></p> <ol style="list-style-type: none"> 15. Glibenclamide 16. Glurenorm 17. Glimeprid 18. Gliclazide (Diabeton) <p><i>A-Glucosidase Inhibitors</i></p> <ol style="list-style-type: none"> 19. Acarbose (glucobay) <p><i>Thiazolidinediones</i></p> <ol style="list-style-type: none"> 20. Pioglit 21. Roglit <p><i>Dipeptidyl peptidase 4 (DPP-4) inhibitors</i></p> <ol style="list-style-type: none"> 22. Januvia <p><i>Glinides (meglitinides)</i></p> <ol style="list-style-type: none"> 23. Repaglinide (Novonorm) <p><i>GLP1 receptor agonists</i></p> <ol style="list-style-type: none"> 24. Liraglutide 25. Exenatid <p><i>SGLT-2 inhibitors (glyflosins)</i></p> <ol style="list-style-type: none"> 26 Dapagliflozin (Forsiga) 27 Empagliflozin (Jardins)
Mechanism of action	Binding to insulin receptors, inclusion in the cytoplasmic membrane of intracellular vesicles with glucose transfer proteins, transport of glucose to the cell.	<ol style="list-style-type: none"> 1. ↓ gluconeogenesis, ↓ absorption of glucose from the gastrointestinal tract and ↑ its utilization by peripheral tissues (muscle and adipose) (14) 2. ↑ insulin secretion by the pancreas. ↑ sensitivity of insulin receptors to insulin (15-18) 3. Interferes with the biotransformation of sucrose and starch to well-absorbed monosaccharides (19) 4. Stimulation of specific nuclear γ-receptors activated by peroxisomal proliferator: ↓ insulin resistance (20-21) 5. Inhibition of the DPP-4 enzyme. ↑ the level of incretin hormones: glucagon-like peptide 1 (GLP-1) and glucose-dependent insulinotropic polypeptide (GIP). GLP-1 and GIP ↑ insulin synthesis and its release from beta cells (22) 6. Blockade of ATP-dependent channels in β-cell membranes => depolarization and opening of Ca^{2+} channels => ↑ insulin secretion by β-cells (23) 7. Glucose-dependent stimulation of insulin secretion, ↓ glucagon secretion (24,25) 8. ↓ reabsorption of glucose in the kidneys, ↓ body weight, insulin-independent mechanism (26,27)
Pharmacological effect	<ol style="list-style-type: none"> 1. Hypoglycemic 2. Anabolic (enhancing the synthesis of proteins and fats) 3. Anticatabolic (↓ protein hydrolysis and lipolysis) 	<ol style="list-style-type: none"> 1. Hypoglycemic 2. ↑ secretion of insulin (15-18, 22-25)
Indications for use	<ol style="list-style-type: none"> 1. Type 1 diabetes mellitus 2. Type 2 diabetes mellitus (resistance to oral hypoglycemic agents, intercurrent diseases, pregnancy) 	<ol style="list-style-type: none"> 1. Type 2 diabetes mellitus 2. Obesity (14-18)
Side effects	<ol style="list-style-type: none"> 1. Hypoglycemia 2. Visual impairment 3. Lipodystrophy in the injection site. 	<ol style="list-style-type: none"> 1. Hypoglycemia 2. Nausea, vomiting 3. Diarrhea 4. Genital infections, urinary tract Infections (26,27) 5. Hypovolemia (26,27) 6. Pregnancy and lactation
Contraindications	<ol style="list-style-type: none"> 1. Hypoglycemia, 2. Hypersensitivity 	<ol style="list-style-type: none"> 1. Type 1 diabetes mellitus 2. Diabetic ketoacidosis 3. Dysfunction of the liver and kidneys

NB!	Rules for insulin administration: <ul style="list-style-type: none"> • Short-acting insulin: 30 minutes before meals. • intermediate-acting insulin: 45-60 minutes before meals. (Both types - to simulate stimulated secretion of insulin) • Long-acting insulin: once a day to simulate the basal secretion of insulin.
-----	---

<i>Adrenal gland hormones</i>		
Classification	Adrenal cortex hormones	Adrenal medulla hormones
Drugs	Mineralocorticoids 1. Fludrocortisone (florinef) Glucocorticoids (see below) Sex hormones (see below)	2. Adrenaline 3. Noradrenaline
Mechanism of action	1. ↑ reabsorption of Na + and water in the distal part of the renal tubules 2. ↑ secretion of K + and H +.	1. Stimulation of α and β-adrenergic receptors 2. Stimulation of α1 and α2-adrenoreceptors, weakly - β1-adrenergic receptors
Pharmacological effect	1. Water and sodium retention in the body 2. ↑ Blood pressure 3. ↓ synthesis of ACTH	1. Spasm of peripheral vessels 2. ↑ blood pressure 3. Tachycardia (1) 4. Bronchodilation (1) 5. ↓ intraocular pressure (1) 6. Bradycardia (2)
Indications for use	1. Primary and secondary adrenal insufficiency 2. Adrenogenital syndrome 3. Hypovolemia 4. Arterial hypotension	1. Immediate type allergic reaction, bronchospasm, asystole, arterial hypotension, hypoglycemia, glaucoma, bleeding from the surface vessels. Prolongation of the action of anesthetics in combined application (2) 2. Acute ↓ blood pressure (3)
Side effects	1. Arterial hypertension 2. Peripheral edema 3. Hypokalemia	1. Angina pectoris, arrhythmia, psychomotor agitation, nausea, vomiting, hypokalemia (2) 2. Bradycardia, myocardial ischemia (3)
Contraindications	1. Systemic mycoses	1. Hypertrophic obstructive cardiomyopathy, pheochromocytoma, arterial hypertension, tachyarrhythmia, IHD, ventricular fibrillation, pregnancy (2) 2. Thrombosis of mesenteric and peripheral vessels (as causes their constriction), pronounced hypoxia and hypercapnia (3)

<i>Glucocorticoids</i>		
Glucocorticoids are steroid hormones synthesized by the adrenal cortex, and their synthetic analogs.		
Classification	Natural	Synthetic
Drugs	1. Cortisone 2. Hydrocortisone	3. Prednisolone 4. Prednisone 5. Methylprednisolone 6. Beclomethasone 7. Triamcinolone 8. Budesonide

Mechanism of action	They interact with nuclear receptors that regulate the transcription of genes, and change the synthesis of proteins and enzymes.	
Pharmacological effect	<p>Anti-inflammatory: inhibition of phospholipase A2, inhibition of the synthesis of prostaglandins and leukotrienes.</p> <p>Immunosuppressive: ↓ activity of leukocytes and tissue macrophages, ↓ lymphocytes count.</p> <p>Antiexudative, antiproliferative effects.</p> <p>Anti-shock effect</p> <p>Suppression of fibroblasts and collagen synthesis.</p> <p>Anabolic: stimulation of gluconeogenesis, lipogenesis. Deposition of glycogen.</p> <p>Catabolic: in the connective, bone, lymphoid tissue.</p> <p>↑ secretion of ACTH, FSH, TTG.</p> <p>↑ brain excitability.</p> <p>↑ production of hydrochloric acid and pepsin.</p>	
Indications for use	<ol style="list-style-type: none"> 1. Chronic adrenal insufficiency 2. Acute adrenal insufficiency 3. Rheumatological diseases 4. Emergencies (asthmatic status, collapse, anaphylactic shock, cerebral edema) 5. Autoimmune diseases 6. Allergic diseases 7. Bronchial asthma 8. Severe inflammatory processes 9. Malignant tumors 10. Prevention of transplant rejection 	
Side effects	<ol style="list-style-type: none"> 1. Steroid ulcers 2. Type 2 diabetes mellitus 3. Hypertension 4. Immunosuppression and attachment of secondary infection 5. Poor healing of wounds, striae 6. Inhibition of adrenal function 7. Cushing's syndrome 8. Hypercoagulation 9. Growth retardation in children 10. Hypokalemia 11. Arrhythmias, seizures 12. Hallucinations, psychosis 	
Contraindications	<ol style="list-style-type: none"> 1. Viral, fungal, bacterial diseases 2. Acid-dependent diseases of the digestive tract 3. Diabetes mellitus 4. Thyrotoxicosis, hypothyroidism 5. Myasthenia gravis 6. Glaucoma 7. Immune deficiency 8. Thrombophilic conditions 	<p>Absolute: intolerance.</p> <p>Relative: tuberculosis, viral infections, acute myocardial infarction (scar rupture is possible), psychosis, epilepsy, peptic ulcer, diabetes mellitus.</p>
NB!	<p>Equivalent doses of GCs: 5 mg of prednisolone = 25 mg of cortisone = 20 mg of hydrocortisone = 4 mg of methylprednisolone = 4 mg of triamcinolone = 0.75 mg of dexamethasone = 0.75 mg of betamethasone</p> <p>Glucocorticoid treatment regimens to prevent adrenal suppression:</p> <ul style="list-style-type: none"> - <i>Alternate-day therapy</i> — treatment once in every 28 hours. Prednisolone or methylprednisolone in the morning; - <i>Intermittent therapy</i> — short-term therapy (3–4 days) with 4-day breaks between courses; - <i>Pulse therapy</i> — short-term high-dose (1 g) urgent therapy. The drug of choice is methylprednisolone (better enters inflamed tissues and less often causes side effects). 	

Female sex hormones and their antagonists

Classification	Estrogens	Anti-estrogens	Gestagens	Antigestagens
Drugs	1. Estriol 2. Estradiol 3. Ethinylestradiol (see <i>Hormonal contraception</i>)	1. Tamoxifen 2. Toremifene 3. Fulvestrant	1. Dienogest 2. Dydrogesterone 3. Progesterone 4. Norethisterone <i>see Hormonal contraception</i>	12. Mifepristone
Mechanism of action	Binding to estrogen receptors (in the uterus, vagina, mammary gland, liver, hypothalamus, ovaries), changes in the gene transcription and protein synthesis	Competitive binding to estrogen receptors in the target organs	Binding to progesterone receptors in the endometrium	Competitive blockage of progesterone receptors
Pharmacological effect	1. Growth and differentiation of the vaginal epithelium 2. Stimulation of the development of secondary sexual characteristics 3. Proliferation of the endometrium 4. ↓ lactation 5. ↓ bone resorption 6. Antimineralocorticoid, antiandrogenic effects (3)	1. ↑ secretion of gonadotropins (prolactin, FSH, LH), stimulation of ovulation (small doses) 2. ↓ secretion of gonadotropins and ovulation (large doses)	1. ↓ uterine excitability during pregnancy 2. Endometrium progress to a secretory phase (cessation of proliferation, transition of the uterine mucosa from the proliferative phase to the secretory one)	1. ↑ contractile activity of myometrium 2. Desquamation of the decidua of the uterus, fertilized egg is expelled
Indications for use	1. Atrophy of the vaginal mucosa due to estrogen deficiency (1) 2. Amenorrhea, menopause, postmenopausal osteoporosis; Substitution therapy after ovarian excision (2) 3. Contraception, acne, severe form of PMS (3)	Estrogen-dependent tumors: 1. Breast Cancer 2. Breast cancer in men after castration (4-5) 3. Kidney cancer (4-5) 4. Melanoma (4-5) 5. Ovarian cancer (4-5) 6. Prostate cancer (4-5)	1. Endometriosis (7, 8) 2. Threatening miscarriage (8) 3. Dysmenorrhea (8) dysfunctional uterine bleeding (8) 4. Progesterone deficiency (9), infertility (9) 5. PMS (10) 6. Mastodinia (9, 10)	1. Early medical abortion (up to 42 days amenorrhea) 2. Induction of labor 3. Emergency postcoital contraception (up to 72 hours) 4. Leiomyoma of the uterus
Side effects	1. Libido changes 2. Soreness of the mammary glands 3. Uterine and vaginal bleeding 4. Fluid retention	1. Thrombosis 2. Fluid retention 3. Dysmenorrhea 4. ↑ risk of proliferative changes in the endometrium 5. Dyspepsia	1. Acne 2. Fluid retention 3. ↑ body weight 4. Dysmenorrhea	1. Bleeding 2. Pain in the lower abdomen 3. Inflammation of the uterus and appendages 4. Dysmenorrhea, amenorrhea 5. Violation of hemostasis
Contraindications	1. Thrombosis 2. Estrogen-dependent tumors 3. Pregnancy, lactation	1. Pregnancy, lactation 2. Tumor or pituitary insufficiency	1. Depression, insomnia 2. Thrombosis 3. Hormone-dependent tumors 4. Uterine bleeding	1. Adrenal insufficiency 2. Long-term GCs intake 3. Renal and / or hepatic impairment 4. The scar on the uterus 5. Inflammatory diseases of female genital organs

Hormonal contraception

Hormonal contraceptives are synthetic analogues of female sex hormones preventing pregnancy.

Classification	Gestagens		Combined_oral_contraceptive_pills (estrogen+gestagen)
Drugs	<p>Progestogen-only pills</p> <ol style="list-style-type: none"> 1. «Exluton» (lynestrone) 2. «Cerazette», «Lactinette» (desogestrel) <p>Injection</p> <ol style="list-style-type: none"> 3. «Depo-provera» (Medroxyprogesterone) <p>Birth-control implants</p> <ol style="list-style-type: none"> 4. «Implanon» (etonogestrel) <p>Hormone-releasing intrauterine systems</p> <ol style="list-style-type: none"> 5. «Mirena» (levonorgestrel) <p>Morning after pills(post-coital, emergency contraception)</p> <ol style="list-style-type: none"> 6. «Postinor», «I-pill», «Plan B» (levonorgestrel) 		<p>Monophasic</p> <ol style="list-style-type: none"> 7. «Loestrin» (ethinyl estradiol + norethindrone acetate) 8. «Yasmin» (drospirenone/ethinyl estradiol) <p>Biphasic</p> <ol style="list-style-type: none"> 9. «Aranelle» (norethindrone/ethinyl estradiol) 10. «Mircette» (desogestrel/ethinyl estradiol) <p>Triphasic</p> <ol style="list-style-type: none"> 11. «Tri-Levlen» (levonorgestrel/ethinyl estradiol) 12. «Tri-Sprintec» (norgestimate/ethinyl estradiol) 13. «Triphasil» (levonorgestrel/ethinyl estradiol)
Mechanism of action	See the table "Female sex hormones and their antagonists"		
Pharmacological effect	<ol style="list-style-type: none"> 1. Suppression of ovulation, ↑ mucus viscosity of the cervix, oppression of the transport function of the fallopian tubes (1-4, 6-16) 2. ↓ Implantation properties of the endometrium, thickening of the mucous cervical canal (5, 6) 		
Indications for use	<ol style="list-style-type: none"> 1. Contraception 2. Polycystic ovary syndrome 3. Anovulatory infertility (stimulation of superovulation upon cancellation) 4. Painful menstruation 5. PMS 		
Side effects	<ol style="list-style-type: none"> 1. Dysmenorrhea 2. Lability of mood 3. Change in body weight 4. Pain of the mammary glands 5. Change in libido 	<ol style="list-style-type: none"> 1. Change in libido 2. Pain in the mammary glands 3. Uterine and vaginal bleeding 4. Fluid retention 5. Acne 6. ↑ body weight 7. Dysmenorrhea 	
Contraindications	<ol style="list-style-type: none"> 1. Thromboembolism 2. Progesterone and estrogen-dependent tumors 3. Uterine and vaginal bleeding 	<ol style="list-style-type: none"> 1. Thromboembolism 2. Progesterone and estrogen-dependent tumors 3. Uterine and vaginal bleeding 	
NB!			<p>Features of the composition of combined contraceptives:</p> <ul style="list-style-type: none"> • Monophasic - all tablets have the same content of estrogens and progestins. • Biphasic - ↑ the progestogen content of the drug in the second phase of the menstrual cycle. • Triphasic - ↑ dose of progestogen in tablets occurs in 3 stages. This mimics the level of hormones in the physiological menstrual cycle.

Androgens and their antagonists

Androgens are preparations of male sex hormones.

Antiandrogens (testosterone blockers) are drugs eliminating effects of male sex hormones.

Antiandrogens (testosterone blockers) are drugs eliminating effects of male sex hormones.		
Classification	Androgens	Antiandrogens
Drugs	1. Testosterone (andriol, androgel, nebido) 2. Mesterolone (proviron) 3. Testosterone esters (sustanon)	Androgen recertor antagonists <i>Steroidal</i> 4. Cyproterone (Androcur, Diane) <i>Non-steroidal</i> 5. Flutamide (Eulexin) 6. Bicalutamide (Casodex) Antigonadotropins <i>Estrogens</i> <i>Gonadotropin releasing hormone analogues</i> <i>Progestogens (see below)</i> Androgen synthesis inhibitors 7. Abiraterone (Zytiga)
Mechanism of action	Binding to androgen receptors of target cells	1. Inhibition of the enzyme CYP17 converting pregnenolone and progesterone into testosterone precursors (7) 2. Competitive binding to tissue receptors of androgens in target organs (4-6)
Pharmacological effect	1. Anabolic: stimulation of protein synthesis, potassium retention and calcium fixation in bones. 2. ↑ reabsorption of sodium. 3. Maintaining the male phenotype and androgen-dependent functions (spermatogenesis, sex glands)	Antiandrogenic
Indications for use	1. Hormone replacement therapy of hypogonadism (1, 2, 3) 2. In men: psycho-vegetative disorders, ↓ performance, potency disorders, infertility, aplastic anemia. (2) 3. In men: impotence of endocrine genesis, post-stroke syndrome, oligospermia, hypo-androgenic osteoporosis. In women: hormone-dependent tumors, menopause, functional bleeding in hyperestrogenism, uterine fibroids (3)	1. Prostate cancer 2. Hirsutism 3. Androgenic alopecia in women, acne and / or seborrhea
Side effects	1. Hypercalcemia 2. Thrombophlebitis 3. Vyrilization 4. ↑ libido 5. Priapis 6. Acne 7. Diarrhea	1. Hepatotoxicity, dyspepsia, fractures, arterial hypertension, hypokalemia, hypertriglyceridemia, heart failure, angina pectoris, arrhythmias 2. Change in body weight, suppression of spermatogenesis, gynecomastia, depression 3. Diarrhea, jaundice, hepatitis
Contraindications	1. Prostate or breast cancer 2. Liver tumors 3. Hypercalcemia	1. Severe liver dysfunction 2. Cachexia, severe depression, thromboembolism, decompensated diabetes mellitus, pregnancy 3. Severe kidney and thyroid disease

Anabolic steroids

Preparations that simulate the action of testosterone and have a pronounced anabolic effect.

Classification	Androstane derivatives	Estrene derivatives
Drugs	<ol style="list-style-type: none"> 1. Methandrostenolone (dianabol, danabol, naposim) 2. Turinabol 3. Oxymetholone (anapolone, anadrol) 4. Boldenon (equipoz, boldabol) 	<ol style="list-style-type: none"> 5. Nandrolone (retabolil, deca-durabolin) 6. Trenbolone (tren, parabолane)
Mechanism of action	Binding to androgen receptors of target cells	
Pharmacological effect	<ol style="list-style-type: none"> 1. Anabolic: increase in muscle mass, ↑ red blood cells count, fixation of calcium in bone tissue, ↓ fat stores, ↑ appetite. 2. Androgenic: masculinization, virilization, hair loss on the head and ↑ their growth on the body, ↑ libido. 	
Indications for use	<ol style="list-style-type: none"> 1. Cachexia, asthenia 2. Osteoporosis 3. Chronic liver and kidney disease 4. Reconvalescence period after severe injuries, surgeries, burns 5. Severe infectious diseases accompanied by loss of protein 6. Correction of catabolic effects of glucocorticoids 7. Progressive muscular dystrophy. 	
Side effects	<ol style="list-style-type: none"> 1. ↑ libido 2. ↑ Blood pressure 3. Acne 4. Edema 5. Hypertrophy of the prostate, testicular atrophy 6. Gynecomastia 7. Masculinization 8. Hepatotoxicity 9. Hypertrophy of the myocardium and ischemia 10. Irritability ("roid rage") 	
Contraindications	<ol style="list-style-type: none"> 1. Prostate Cancer 2. Acute liver disease 3. Decompensated diabetes mellitus 4. Acute and chronic prostatitis 5. Pregnancy, lactation 6. The pubertal age. 	