Ministry of health of the Republic of Belarus
Educational institution
«Gomel State Medical University»

Department of general and clinical pharmacology

Authors:
B.S. Yarashevich, senior lecturer
A.V.Sennikava, senior lecturer
E.I. Mikhailova, head of department, M.D., prof.

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 3: « PARENTERAL DOSAGE FORMS. SOFT DOSAGE FORMS »

Time: 3 hours

Approved at the meeting of the department of general and clinical pharmacology
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2022

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

The share of medicines released, both in the form of injections and in the form of soft dosage forms, in a modern pharmacy accounts for up to 40% of the dispensed prescriptions. Dosage forms for injection provide rapid development of the effect and its good manageability, which is very important, especially in extreme situations. For this reason, the study of this topic is very appropriate for all students of medical universities, regardless of their chosen specialization.

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 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 follow academic and work discipline, standards 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. Latin terminology: dosage forms, commonly accepted abbreviations.
2. Case endings of Latin nouns I, II, III, IV, V declensions in the genitive case.

CONTROL QUESTIONS ON THE TOPIC OF THE CLASS

1. General characteristics and requirements for dosage forms for injection. Rules for prescribing injection forms of factory and pharmacy manufacture.
2. Soft dosage forms (ointments, pastes, suppositories): rules of manufacture and discharge.
3. Special dosage forms – therapeutic systems (oral, transdermal, parenteral); dosage forms for children.

PROCESS OF THE STUDY

1.
2.
3.
4.
5.

Theoretical part

Parenteral dosage forms

Parenteral preparations are sterile preparations containing one or more active ingredients intended for administration by injection, infusion or implantation into the body.

The different categories of parenteral preparations include:

- injections;
- intravenous infusions (are intended for administration in large volumes – usually more than 100 mL);
- powders for injections or intravenous infusions (are dissolved in sterile water for injections before administration);
- concentrates for injections or intravenous infusions;
- implants (sterile solid preparations containing one or more active ingredients. They are of a size and shape suitable for parenteral implantation and provide release of the active ingredient(s) over an extended period of time).

Solvents for solutions for injections:

– Water for injections.

– Oils (for subcutaneous or intramuscular administration only: oils being administered intravenously cause fat embolism).

– Local anesthetics (novocaine) – usually for antibiotics due to pretty painful administration (but the doctor should be aware of danger of allergy and anaphylaxis).

– Alcohol (rarely).

Types of injections:

- **Intradermal** (ID) – into the dermis, just below the epidermis. It is used for sensitivity tests, like tuberculin and allergy tests, and for local anesthesia.
- **Subcutaneous** (SC) – as a bolus into the subcutis (the layer below the dermis and epidermis). Drugs for SC administration are vaccines, insulin, morphine, diacetylmorphine, heparin and goserelin. Best sites for such injections are sites with enough subcutaneous fat (the abdomen, the upper back, the outer area of the upper arm, the front of the thigh)
- **Intramuscular** (IM) – possible sites for IM injection include: deltoid, dorsogluteal, rectus femoris, vastus lateralis and ventrogluteal muscles. Sites that are bruised, tender, red, swollen, inflamed or scarred are avoided.
- **Intraosseous** (IO) – directly into the bone marrow to provide a non-collapsible entry point into the systemic venous system when intravenous access is not available or not feasible. It is demonstrably superior to intramuscular and comparable to intravenous administration (e.g., in delivering paediatric anaesthetic drugs).
- **Intraperitoneal** (IP) – into the abdominal cavity. It's widely used to administer chemotherapy drugs to treat some cancers, particularly ovarian cancer. Also it's used in peritoneal dialysis – a type of dialysis (removing waste and excess water from the blood) when dialysate fluid is administered into the abdominal cavit. In this case peritoneum works as the membrane through which fluid and dissolved substances are exchanged with the blood. Peritoneal dialysis is used in patients with chronic kidney failure.
- **Intravenous** (IV) – the fastest way to deliver fluids and medications. We can use peripheral veins (in the arms, hands, legs and feet) or a central one. In the latter case drugs are administered through a central venous catheter (=central line) into a large vein – in the neck (internal jugular vein), chest (subclavian vein or axillary vein), groin (femoral vein), or through veins in the arms (also known as a PICC line, or peripherally inserted central catheters). Central line is used for long-term IV administration or when peripheral veins are not available.
- **Intraarterial** (IA) – is used when direct delivery to the organ is demanded. It's chemotherapy of cancer and use of radiopaque substances for diagnostic aim (angiography).

Requirements for parenteral dosage forms:

1. Sterility
2. Stability (no precipitate of the solute)
3. Apyrogenicity (solution shouldn't increase the body's temperature)
4. No mechanical impurities
5. Isotonicity (most often)

How to prescribe parenteral dosage forms? First we give the mane of the substance and its amount in one ampule (flacon). When we write D.t.d.N. ... in ampullis (Give … doses in

ampules), S. and signature. The signature indicates the order of dissolution (dilution) of the substance, the route of administration of the solution (suspension), the time of injection.

Example

1) Prescribe 6 ampules of vincristine (Vincristinum) each containing 0.005 g of the drug. To administer 0.005 g intravenously once weekly preliminary have dissolved the contents of the ampoule into 5 ml of an isotonic sterile solution of sodium chloride.

Rp.: Vincristini 0.005

D.t.d.N. 6 in ampull.

S. The content of the ampoule to be dissolved in 5 ml of an isotonic sterile solution of sodium chloride. IV once a week.

When prescribing solutions and suspensions in ampules first we write the dosage form: *Solutionis* ... (Solution...), *Suspensionis*... (Suspension...), then the name of the drug, type of the solution (if necessary), it's concentration in percentages and its amount. Then we write D.t.d.N. ... in ampullis, S. and signature.

Example

1) Prescribe 10 ampules containing 50 ml of 40% glucose solution (Glucosum). 50 ml to be administered intravenously.

Rp.: Sol. Glucosi 40% – 50 ml

D.t.d.N. 10 in ampull.

S. 50 ml to be administered intravenously slowly.

2) Prescribe 6 ampules containing 1 ml of 2.5 % deoxycorticosterone-dimethyl acetate suspension. (Desoxycorticosteroni trimethylacetas). 1 ml intramuscularly once weekly.

Rp.: Susp. Desoxycorticosteroni trimethylacetatis 2.5% - 1 ml

D.t.d.N. 6 in ampull.

S. 1 ml intramuscularly once weekly.

When prescribing solutions with a certain name we write only the name of the drug and its amount (no concentration). Then D.t.d.N. ... in ampullis, S. and signature.

Example

1) Prescribe 10 ampules containing 1 ml of cordiamine (Cordiaminum – 25% solution of nicotinic acid diethylamide). 1 ml subcutaneously twice daily.

Rp.: Cordiamini l ml

D.t.d.N. 10 in ampull.

S. 1 ml subcutaneously bid.

How to prescribe a drug in a flacon? Rules are the same but it's not obligate to indicate the type of container (we don't write «in flac.» but if you want you can).

Example

1) Prescribe 15 flacons containing 500 000 IU of benzylpenicillin sodium salt (Benzylpenicillinum-natrium). 500 000 IU to be administered intramuscularly 4 times daily. Pre-dilute the contents of the flacon in 2 ml of 0.5% solution of novocaine.

Rp.: Benzylpenicillini-natrii 500 000 IU

D.t.d.N. 12

S. The content of the flacon to be diluted in 2 ml of 0.5% solution of novocaine.

500 000 IU to be administered intramuscularly qid.

2) Prescribe 6 flacons containing 5 ml of 2.5% hydrocortisone acetate suspension (Hydrocortisoni acetas). 1.5 ml for injection into the cavity of the affected joint once a week.

Rp.: Susp. Hydrocortisoni acetatis 2.5% – 5 ml
D.t.d.N. 6
S. Inject 1.5 ml into the cavity of the affected joint once a week.

3) Prescribe 5 flacons containing 5 ml (49 IU in 1 ml) of insulin (Insulinum). 10 IU subcutaneously twice daily 30 minutes before meals.

Rp.: Insulini 5 ml (1 ml – 40 IU)
D.t.d.N. 6
S. 10 IU subcutaneously bid 30 minutes before meals.

When prescribing parenteral preparations made in the pharmacy it's obligate to indicate information on drug's sterilization: *Sterilisetur*! (To be sterilized!). If the preparation contains a few ingredients цкшеу after their enumeration: *M. Sterilisetur!* Then write D.S. and signature.

Example

1) Prescribe 200 ml of 0.5% sterile solution of novocaine (Novocainum) dissolved in 0.9% solution of sodium chloride (Natrii chloridum). For infiltration anesthesia.

Rp.: Novocaini 1.0
Sol. Natrii chloridi 0.9% – 200 ml
M. Steril.!
D.S. Impregnate tissues layer by layer by injection.

Soft dosage forms are *ointments, creams, pastes, liniments, plasters and suppositories.*

Ointments – Unguenta *(Ointment: Nom. Single Unguentum,*
Gen. Single Unguenti)

An **ointment** is a homogeneous, viscous, semi-solid preparation, most commonly a greasy, thick oil (oil 80% - water 20%) with a high viscosity, that is intended for external application to the skin or mucous membranes (=topical administration)

The vehicle of an ointment is known as the *ointment base*. The choice of a base depends upon the clinical indication for the ointment.

Types of ointment bases are:

- Hydrocarbon bases, e.g. hard paraffin, soft paraffin, microcrystalline wax and ceresine
- Absorption bases, e.g. wool fat, beeswax
- Water-soluble bases, e.g. macrogols 200, 300, 400
- Emulsifying bases, e.g. emulsifying wax, cetrimide
- Vegetable oils, e.g. olive oil, coconut oil, sesame oil, almond oil and peanut oil.

There are simple (2 ingredients: base and active component) and composite ointments (base+a few active ingredients).

Most often ointments are made in the factory, not in the pharmacy. That's why they are prescribed in a short form, without specifying their composition and concentration. First we write the word *Unguenti* (*Gen. Single)*

Example

1) Prescribe 20.0 g of zinc ointment (Unguentum Zinci). Apply to affected skin.

Rp.: Ung. Zinci 20.0

D.S. Apply to affected skin od. (*It's necessary to indicate frequency of use)*

Ointments with trade names are prescribed similarly (e.g., Unguentum «Efcamonum»).

When prescribing ointments made in the pharmacy we write concentration of the ointment and its total amount.

Example

1) Prescribe 50.0 g of ointment containing 1% of neomycin sulfate (Neomycini sulfas). Apply to affected skin.

Rp.: Ung. Neomycini sulfatis 1% – 50.0

D.S. Apply to affected skin tid.

If the ointment should be made in the pharmacy and the doctor doesn't specify type of base the pharmacist will use vaseline. In many languages, the word "Vaseline" is used as generic for petroleum jelly (=petrolatum, white petrolatum, soft paraffin/paraffin wax), a semi-solid mixture of hydrocarbons.

Base for eye ointments: 10 parts of anhydrous lanolin and 90 parts of vaseline for eye ointments.

If there are a few active components in the ointment we should list all of them and their amount. The prescription ends with a phrase *M.f. unguentum* (Misce fiat unguentum. – Mix to make up an ointment).

Example

1) Prescribe 5.0 g of ointment containing lanolin and vaseline (1:9) and 20% of sulfacyl sodium (Sulfacylum-natrium). Put under the eyelid 3 times a day.

Rp.: Sulfacyli-natrii 1.0
Lanolini 0.4
Vaselini ad 5.0
M.f .ung.
D.S. Put under the eyelid tid.

A doctor usually prescribes 20.0-100.0 of skin ointment and 5.0-10.0 g of eye ointment.

Active components may have resorptive or reflectory action. In this case, the ointment penetrates the ducts of the sebaceous glands; the degree of penetration is determined by the physico-chemical properties of the medicinal substances and base in the ointment. It should be borne in mind that the suction capacity of the skin is *enhanced by maceration (*the softening and breaking down of skin resulting from prolonged exposure to moisture), *hyperemia (inflammation), degreasing of the epidermis* (the action of organic solvents).

Pastes – Pastae *(Paste: Nom. Single Pasta*
Gen. Single Pastae)

Paste combines three agents – oil, water, and powder. It is an ointment in which a powder is suspended (25%-65% of ointment).

Due to it pastas in contrast to ointments have pronounced adsorbing and drying properties.

Paste characteristics:

– Opaque, viscous, greasy to mildly greasy.
– Adheres well to the skin, forming a protective layer.

– Stiff and impermeable.
– Applied on oozing lesions to absorb serous secretions
– Not suited for application to hairy parts of the body

One class is made from a single-phase aqueous gel (Carboxymethylcellulose Sodium Paste). The other class, the fatty pastes (Zinc Oxide Paste), consists of **thick, stiff ointments** that **do not ordinarily flow at body temperature** and therefore serve as **protective coatings** over the areas to which they are applied.

If the paste should be made in the pharmacy a doctor lists all the paste components in the prescription. The prescription ends with a phrase: *M.f. pasta* (Misce ut fiat pasta. – Mix to make up a paste).

If the amount of powdered substances in the paste is less than 25% it's necessary to add an indifferent powder like starch (Amylum), zinc oxide (Zinci oxydum), white clay (Bolus alba) and etc.

Example

1) Prescribe 50.0 g of Vaseline paste (Vaselinum) containing 20% of iodoform (Iodoformium). Apply to affected skin.

Rp.: Iodoformii 10.0
Amyli
Zinci oxydi aa 5.0
Vaselini ad 50.0
M., f. past.
D.S. Apply to affected skin bid.

2) Prescribe 25.0 g of zinc-salicylic paste (Pasta Zinci-salicylata). Apply to affected skin.

Rp.: Past. Zinci-salicylatae 25.0
D.S. Apply to affected skin od.

Liniments – Linimenta *(Liniment: Nom. Single Linimentum, Gen. Single Linimenti)*

Actually, it's a liquid ointment. Liniment is a solution or mixture of various substances in oil, alcoholic solutions of soap, or emulsions intended for external application.

Liniment characteristic

Liquids or semisolids

- Applied with friction and rubbing of the skin, the oil or soap base providing for ease of application and massage (embrocations)

Alcoholic liniments

- Used for their *rubefacient, counterirritant, mildly astringent, and penetrating effect;*
- Penetrate skin more readily than those with an oily base;
- Induces redness of the skin, e.g. by causing dilation of the capillaries and an increase in blood circulation (e.g. capsaicin, salicylates).

Oily liniments

- Milder in action;
- More useful when massage is required;

Most extensively used as *counterirritants* intended to treat *muscle or joint pain* by producing a feeling of heat in the area (camphor liniment).

Bases for oily liniments:

- Oleum Helianthi (sunflower oil)
- Oleum Lini (linseed oil)
- Oleum Olivarum (olive oil)
- Oleum Ricini (castor oil).
- Oleum jecoris Aselli (cod liver oil)

Liniments also contain *antipruritics, astringents, emollients, or analgesics.*

Should not be applied to bruised or broken skin.

Applications need to be marked clearly that "For External Use Only".

Example

1) Prescribe 40.0 g of a liniment containing 10.0 of methyl salicylate, chloroform and sunflower oil. For grinding the affected joint.

Rp.: Methylii salicylatis 10.0
Chloroformii
Ol. Helianthi aa 15.0
M., f.lin.
D.S. Rinse the affected joint bid.

Calculation: 40.0 g of liniment contains 10.0 methyl salicylate, meaning that chloroform and sunflower oil should total 30.0, equally 15.0

2) Prescribe 30.0 of a liniment containing 10% of sintomycin. Apply to affected skin.

Rp.: Lin. Synthomycini 10% – 30.0
D.S. Apply to affected skin tid.

Suppositories – Suppositoria *(Suppository: Nom. Single Suppositorium, Gen. Single Suppositorium, Gen. Plur. Suppositoria)*

Suppository is a dosage form solid at room temperature and melting at body temperature. It is inserted into the rectum (rectal suppository), vagina (vaginal suppository) or urethra (urethral suppository), where it dissolves or melts and exerts local or systemic effects.

Several different ingredients can be used to form the base of a suppository: cocoa butter or a similar substitute, polyethylene glycol, hydrogels and glycerinated gelatin. The base has dense consistency, it melts at body temperature (not above 37˚C), doesn't have irritating properties, is poorly absorbed through mucous membranes, doesn't interact with medicinal substances.

Advantages:

– Direct ingestion of a drug substance into the total bloodstream (bypassing the gastrointestinal tract),
– Absorption rate identical to the one in IM administration
– Independence of the absorption from the digestive tract,
– Convenience when used in pediatric practice, geriatrics and psychiatry
– Simplicity, painlessness and lack of possibility of infection.

Rectal suppositories usually have the form of a cone or cylinder with a pointed end. Their mass varies from 1.1 to 4.0 g. The maximum permissible diameter is 1.5 cm. If the mass of rectal suppositories is not indicated in the prescription then they are made in a mass of 3.0.

Vaginal suppositories can be spherical (balls – globuli), ovoid (ovula) or have the form of a flat body with a rounded end (pessaries – pessaria).

The weight of vaginal suppositories is from 1.5 to 6.0 g. If the mass of vaginal suppositories is not indicated in the prescription, then they are usually made with a mass of 4.0.

Example

1) Prescribe 10 rectal suppositories «Betiol» («Bethiolum»). 1 suppository twice daily.

Rp.: Supp. «Bethiolum» N. 10

D.S. 1 suppository into the rectum 2 times a day.

The amount of the base can be omitted in the prescription (cause the pharmacist knows how much is necessary). In this case, write *q.s.* instead of the quantity of the formative substance (*Quantum satis* – As much as you need).

Example

1) Prescribe 6 rectal suppositories containing 0.02 g of promedol (Promedolum). 1 suppository for pain.

Rp.: Promedoli 0.02
Olei Cacao 3.0
M.f. supp. rect.
D.t.d.N. 6
S. 1 suppository into the rectum for pain.

Patches

A patch is a **drug delivery system** that often contains an adhesive backing that is usually applied to an external site on the body.

Its ingredients either **passively diffuse from**, or are **actively transported from**, some portion of the patch. Depending upon the patch, the ingredients are **either delivered to the outer surface** of the body or **into the body**.

Sometimes synonymous with the terms 'extended release film' and 'system'.

Transdermal patches

Consists of a protective backing, a matrix/reservoir containing active drug, an adhesive that allows the patch to adhere to the skin, and a release liner to protect the skin adhering adhesive. e.g. nicotine patch, contraceptive patch.

Parts of a transdermal patch:

Clear backing → drug reservoir → drug-release membrane → contact adhesive.

Plasters

Substance intended for external application made of such materials and of such consistency as to adhere to the skin and attach to a dressing; plasters are intended to afford protection and support and/or to **furnish an occlusion and macerating action** and to bring medication into close contact with the skin.

Can be solid or semisolid.

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. Modern methods of sterilization of dosage forms for injection (filling of workbooks).
2. Rectal therapy: its advantages and disadvantages.

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. Кратко о лекарственных средствах : учеб.-метод. пособие для студентов 3 курса лечеб., мед.-диагност. фак. и фак. подг. спец. для зарубеж. стран, 6 курса ле-

чеб. фак. и фак. подг. спец. для зарубеж. стран, аспирантов, магистрантов, учреждений мед. образования : в 2 ч. / Е. И. Михайлова [и др.]. – Гомель : ГомГМУ, 2019. – Ч. 1. – Гомель: ГомГМУ, 2020. – 56с. – Режим доступа: http://elib.gsmu.by/xmlui/handle/GomSMU/7128 – Дата доступа: 23.05.2022.

3. Кратко о лекарственных средствах : учеб.-метод. пособие для студентов 3 курса лечеб., мед.-диагност. фак. и фак. подг. спец. для зарубеж. стран, 6 курса лечеб. фак. и фак. подг. спец. для зарубеж. стран, аспирантов, магистрантов, учреждений мед. образования : в 2 ч. / Е. И. Михайлова [и др.]. – Гомель : ГомГМУ, 2019. – Ч. 2. – Гомель: ГомГМУ, 2020. – 76с. – Режим доступа: http://elib.gsmu.by/xmlui/handle/GomSMU/7129 – Дата доступа: 23.05.2022.

4. Rang and Dale's Pharmacology / J. M. Ritter [et al.]. - 9th ed. - Edinburg [et al.] : Elsevier, 2020. - xvi, 789 p. : ill., tab. + Student consult online.