THE NATIONAL UNIVERSITY OF PHARMACY
Pharmacology department

Lecture topic:

GENERAL PHARMACOLOGY
(pharmacological alphabet)

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Objectives

- ✔What is pharmacology?
- ✔What is a drug?
- ✔Medication Names
- ✔Pharmacological characteristic of drugs
- ✔Pharmacodynamics
- ✔Typical mechanisms of action of a medicine
- ✔Doses
- ✔Routes of Drugs Administration
- ✔ Steps to Administering Medication

What is Pharmacology ?

Pharmacology is a branch of medical science

- "*Pharmakon*" - Greek word means "an active principle"
- "*Logos*" - Greek word means *"knowledge"*

So, Pharmacology is "*knowledge about drugs*" in common meaning

Definition

- In broad aspect, it is the subject that embraces the knowledge of history, source, physical and chemical properties, compounding, biochemical and physiological effects, mechanism of action, absorption, distribution in the body, storage, biotransformation (or metabolism), excretion and therapeutic

What is a drug?

- The word drug is derived from French word *"Drogue"* [meaning *a dry herb*]
- A drug is defined as any substance used for the purpose of diagnosis, prevention, relief or cure of a disease in man or animal

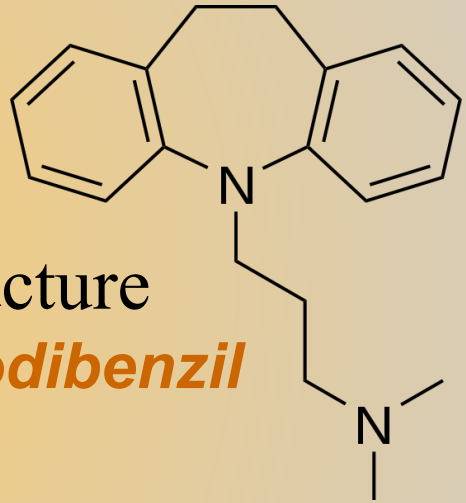
WHO Definition of drug

- Any substance or product that is used or intended to be used to modify or explore physiological system or pathological states for the benefit of the recipie

Sources of Drugs

- Animals
- Plants
- Minerals
- Synthetic
- Microbes
- Biotechnology

Medication Names



- **Chemical Name**
  - describes the drug's chemical structure
    N-(3-dimethylaminopropile)-iminodibenzile hydrochloride
- **International non-patented name** (INN), or Official Name – the name used in the Pharmocopoeia
  - ***Imipramine (Imipraminum)***

Medication Names

- **Trade Name**
  - the name the manufacturer uses to market the drug

Melipramine (Egis, Hungary)

Imizine (Russia)

What is General Pharmacology?

- General Pharmacology is the study of the common patterns of drugs ***Pharmacodynamics*** and ***Pharmacokinetics***

Pharmacological characteristic of drugs

Each drug has

Pharmacokinetics

What body does to drug

Pharmacodynamics

What drug does to body

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Pharmacodynamics

(from Greek ***pharmakon*** – **drug, *dynamis* - power*)***

Pharmacodynamics includes:

A) Biologic effects of the drug: both beneficial & harmful effects

- *What does a drug do in the body?*

B) Localization of action

- *Where does a drug act in the body?*

C) Mechanism of actions of the drug

- *How does a drug act in the body?*

Pharmacodynamics: effects of the drugs

- **Thrapeutic effects**
  - The desired result of drug administration
- **Side effects**
  - Effects that are not desired and that occur ***in therapeutic doses*** in addition to the desired therapeutic effects

Effects and side effects

- Drug effects and side effects result from interaction with individual receptors
- All drugs interact with more than one receptor
- Endogenous molecules usually bind to multiple receptors in the same family
- Drugs are designed to target specific receptor subtypes to reduce side effects
- Increasing the concentration of the drug increases side effects
- Patients experience different effects and side-effects

Drugs do benefit as well as harm

Drugs can do good as well

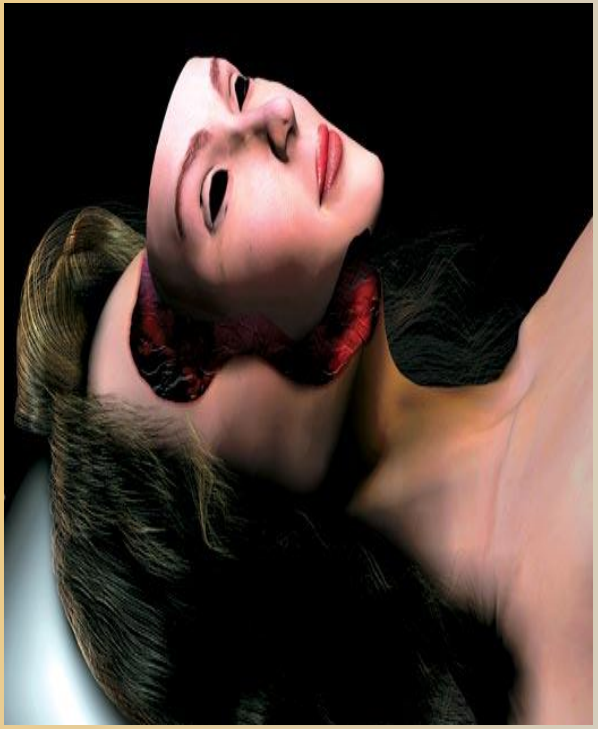
- **Beneficial effects/Therapeuti**
- **Harmful effects / Adverse effe**

So, the knowledge of basic pharmacology is essential for all prescribing physicians and

Drugs do benefit as well as harms

- "Poisons in small doses are the best medicines; and useful medicines in too large doses are poisonous"

William Withering,
discoverer of Digitalis



FACTORS THAT AFFECT Pharmacodynamics of MEDICINES

Exogenous factors unrelated to the patient: chemical structure and physical properties of drugs, medicinal form, route of administration and dose, diet, food composition, environment, chrono-dependence

Endogenous factors related to the patient: body weight, sex, age, physiological (pregnancy, hypodynamy, body temperature) and pathological (disease) conditions

Typical mechanisms of action of a medicine

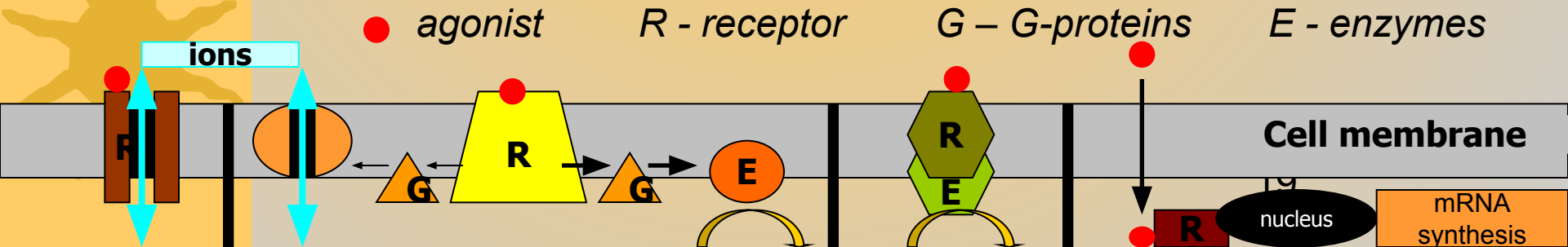
Basic "target" of action of a medicine is **receptor**

Receptors are active groups of substrates' macromolecules, with them a drug interacts.

Receptors are the components of a cell membrane or cytosole that interact with a drug and initiate the chain of biochemical events leading to the drug's observed effects

Types of receptors

1. Receptors directly controlling ion channel function. These are receptors coupled directly with ion channels (nicotinic cholinoreceptors, $GABA_A$-receptors and glutamate receptors).
2. Receptors coupled with effector via ”G-protein – second messengers” or ”G-protein – ion channel” systems (muscarinic cholinoceptors, adrenoceptors).
3. Receptors directly controlling effector enzyme function. They are directly associated with thyrosine kinase and regulate phosphorilation of proteins (insulin receptors and a number of growth factors function this way).
4. Receptors controlling DNA transcription are intracellular receptors (soluble cytosolic or nuclear proteins) unlike membrane receptors of types 1-3. Steroid and thyroid hormones interact with this type of receptors.



Typical mechanisms of action of a medicine

1. Medicines - **agonists** (agonists - the contender): it is provided “**affinity**" (*affinis* - related) medicines.
2. Medicines - **antagonists** or blockers:
   competitive, non-competitive.
3. Medicines - **agonists-antagonists**.
4. Medicines - **modulators** change structure of a receptor, cooperating with its allosteric center.

Receptors, enzymes, ion channels (Na^+, Ca^{2+}, K^+, Cl^- , etc.), transport systems and genes serve as “target" for drugs

Kinds of action of a medicine

For the analysis **pharmacodynamic** distinguish:

- ***Local*** *and* ***resorptive (****or* ***systemic)*** *action;*
- ***Direct*** *and* ***reflex*** *action;*
- ***Selective (predominant)*** *and* ***non-selective*** *action;*
- ***Principal*** *and* ***adverse*** *effects;*
- ***Reversible*** *(characteristic of most drugs) and* ***irreversible action*** *(in a case of covalent bond, as a rule).*

Pharmacotherapeutical kinds of action

- ***Etiotropic***
- ***Pathogenetic***
- ***Symptomatic***
- ***Stimulative***
- ***Subsitutive***
- ***Palliative*** *(time alleviation)*

Negative kinds of drug action

Cumulation: material, functional.
Accustoming (tolerance), tachyphylaxis (rapidly diminishing response to successive doses of a drug, rendering it less effective. The effect is common with drugs acting on the nervous system).
Predilection; euphoria; abstinence.
Medicinal **allergy.**
Medicinal **idiosyncrasy.**
Dysbiosis (dysbacteriosis).
Embriotoxity → teratogenic → mutagen.
Blastomogenic (cancerogenic).
Withdrawal Syndrome

Kinds of doses

Therapeutical:

-Minimal	-Single	-Isolethal
-Average	-Daily	-Isoeffective
-Maximal	-Course	-Equimolecular

Shock and supporting doses

Dose is a quantity of a substance for intake.
Dose is usually measured in **grams** or **gram fractions (mg** and so on**)**, in special cases – in radioactivity units or in biological units (in biostandardization).
For more accurate dosing of drugs their amount is calculated per 1 kg of body mass (for example, mg/kg) or by body surface area (per 1 m2).

Therapeutic index

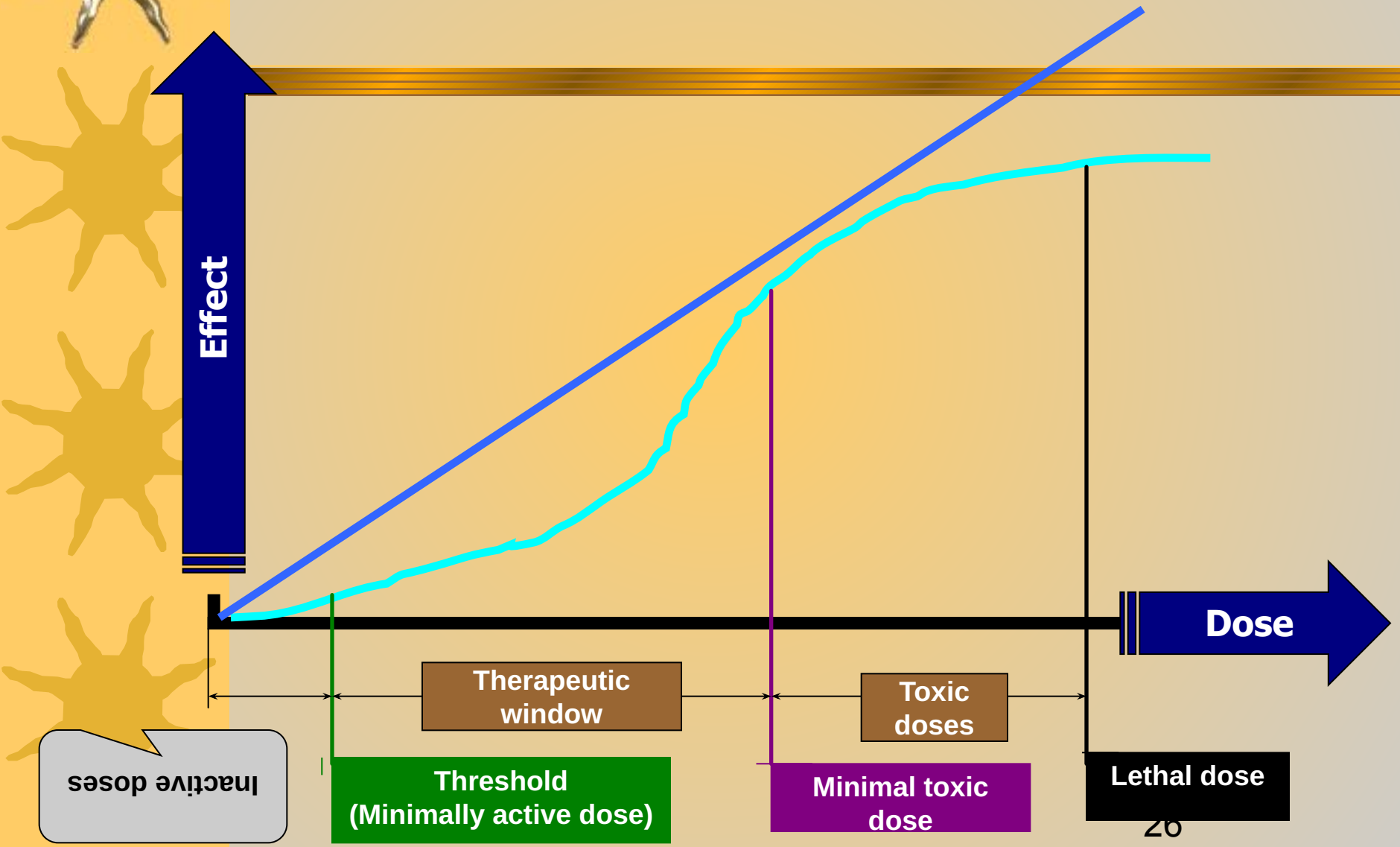
$$TI = \frac{LD_{50}}{ED_{50}}$$

Where

LD_{50} - the dose that causes death in 50% of experimental animals;

ED_{50} - the dose that causes pharmacological effect in 50% of animals.

“Dose-effect” dependence

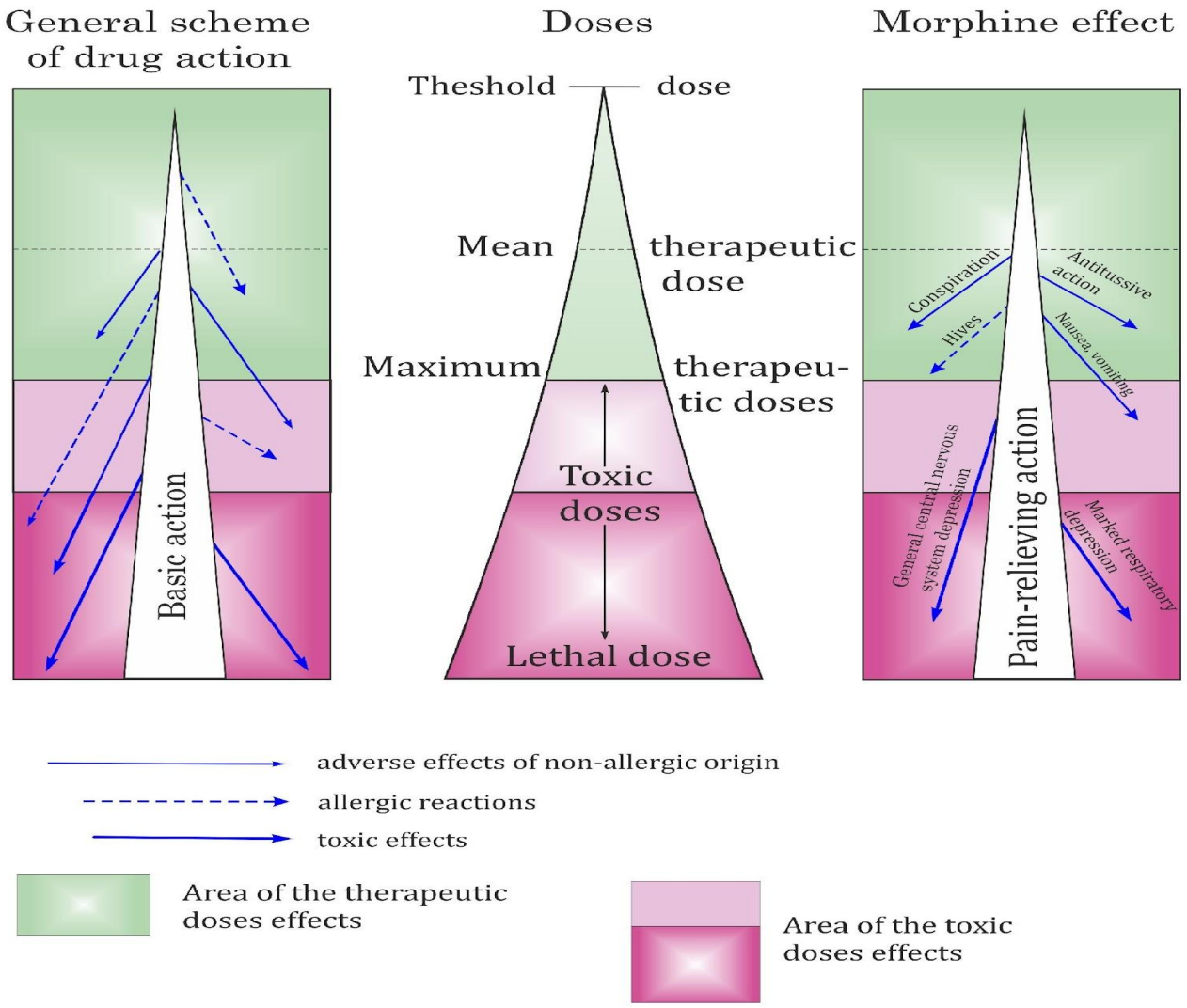


Therapeutic window or breadth of therapeutic action

- This is an interval between minimal therapeutic dose (or concentration) and minimal toxic dose (concentration)

- For safety use of drugs this interval has to be wide enough

Doses, pharmacoterapeutic and adverse effects of drugs



In geriatrics - 1/2-2/3 from an average therapeutic dose

The children's dose (A) is calculated using the formulas:

$$A = \frac{a}{B \cdot (a + 12)}$$

$$A = \frac{B}{(70\ \text{kg}) \cdot B}$$

where

B- a dose of an adult person;
a - age of a child;
B - weight of a child.

The important quality of a medicine is not the "strenth" of its action but the efficiency of a **safe** dose

Routes of Administration of drugs

Enteral (via digestive tract):
Oral, sublingual, transbuccal*, duodenal and rectal routs

* from Latin *bucca* – **cheek**

Parenteral: subcutaneous, intramuscular, intravenous, intra-arterial, intracardial, intrasternal, intraperitoneal, inhalation, subarachnoid, suboccipital and some others

Oral (by mouth, internally, *per os*): The most common administration rote

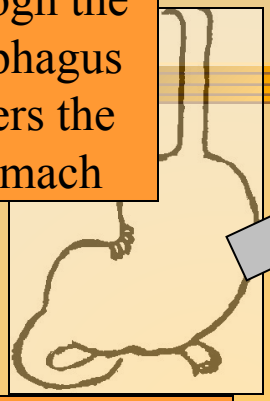
Positive: is a convenient and simple way,
gastrointestinal tract is the "biological filter",
medical personnel and equipment are not needed,
many drugs are used 30-40 minutes before eating or 3-4 hours after it

Disadvantages: the concentration of drugs is not exact,
drugs can be destroyed in the gastrointestinal tract by interaction with food enzymes and hydrochloric acid,
is not suitable for the first aid,
speed and completeness of absorption of drugs can vary,
inactivation in the liver and action on it are possible

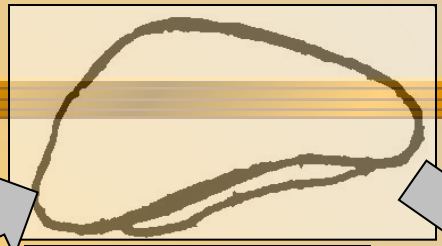
Oral route of administration of medicines

Introduced inside the mouth

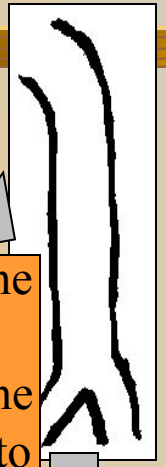
Throgh the esophagus enters the stomach



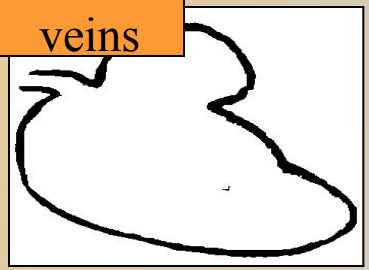
Absorbed from the stomach to the liver through a capillary



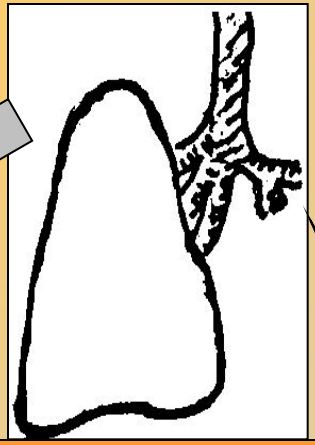
From the liver medicine comes to the bottom nailed veins



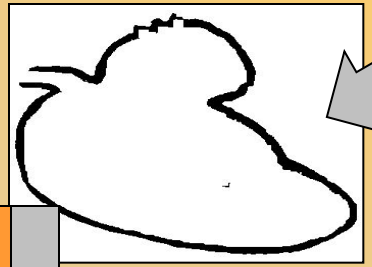
Then to the right atrium and right ventricle



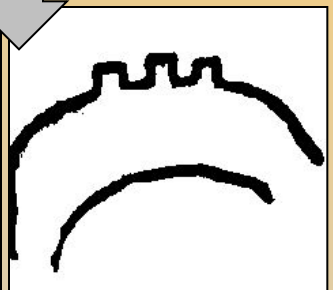
From the right ventricle to the pulmonary artery to lungs



Then to the left atrium and left ventricle



The left ventricle enters the aorta and then to organs and tissues



Rectal administration

Positively: can be used in the unconscious, patients with vomiting, stomach diseases, in mentally ill, children. Absorbtion speed is close to intramuscular way (5-15 minutes). There is a "biological filtration" and no effect of the first passage through the liver.
Disadvantages: uncomfortable way, not all drugs are absorbed.

Sublingual

Quick adsorbtion, drugs are not destroyed in the gastrointestinal tract and less - in the liver.
Only for potent drugs.

Parenteral way

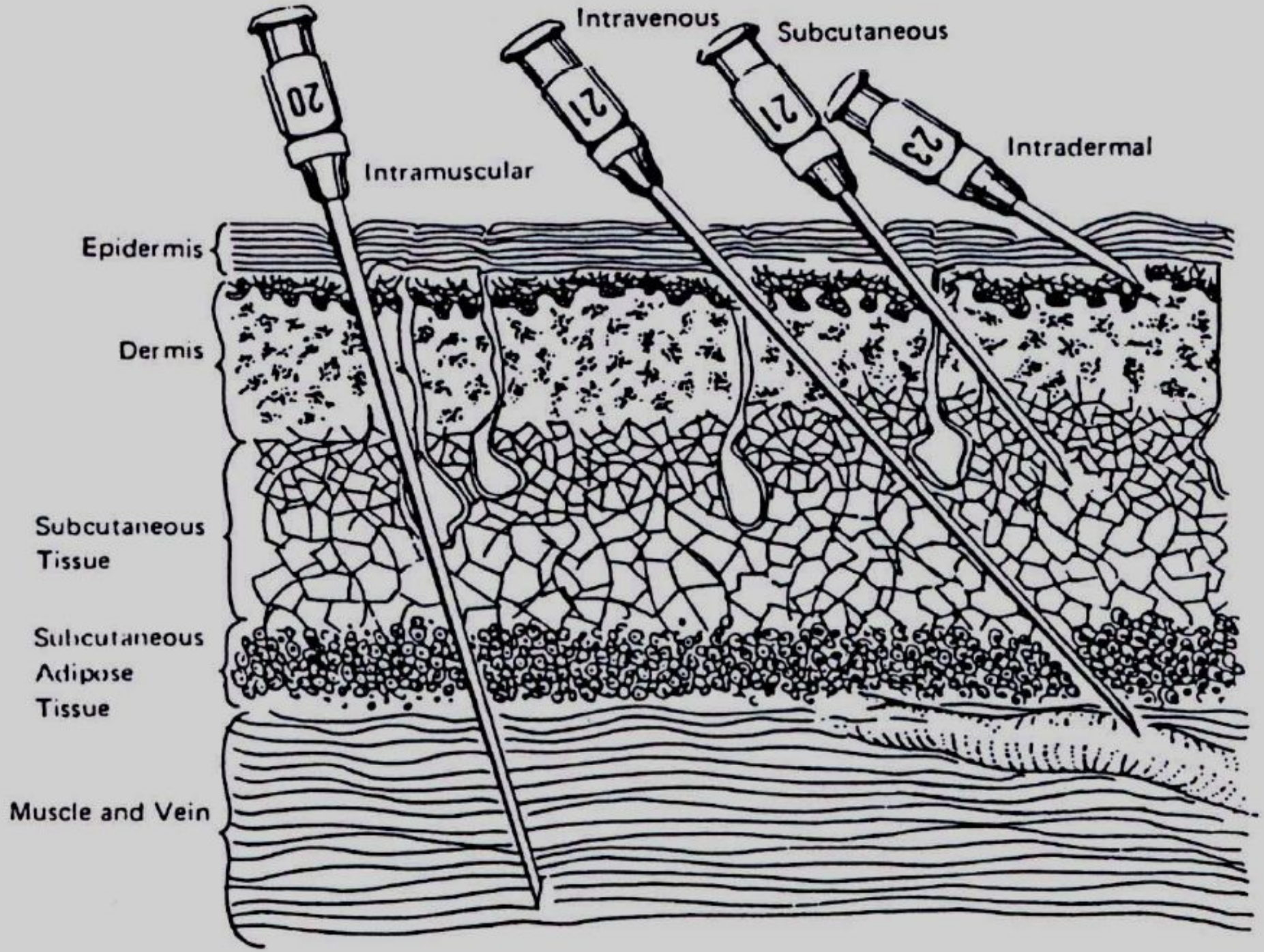
Positive: fast action and accurate dosing,
introduction to the unconscious is possible,
drugs are not destroyed in the gastrointestinal tract including the liver.

Disadvantages:
the need of the strict asepsis,
the participation of medical personnel and equipment is needed,
the risk of infection,
introduction is accompanied with pain.

Parenteral way

Intravenous way - usually under the net-applied conditions. unable to administer oil solutions, suspensions, solutions, causing hemolysis, thrombosis, conversion of hemoglobin to methgemoglobin; danger of platelet-phlebitis.
Subcutaneously - water and oil solutions are injected.
Intramuscularly – quick effect (10-15 minutes), volume should not exced 5 ml.
Inhalation: fat-soluble injected drugs are well absorbed through the alveoli.

Subdural, epidural, transdermal, intracardiac, and others.

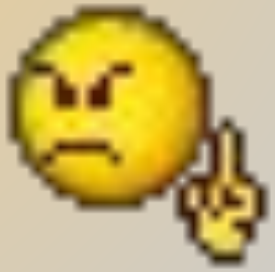

Intravenous
Subcutaneous
20
21
21
23
Intramuscular
Intradermal
Epidermis
Dermis
Subcutaneous Tissue
Subcutaneous Adipose Tissue
Muscle and Vein

Characteristics of the main routes of parenteral injection of medicines

Index	Subcutaneous way	Intramuscularly way	Intravenous way
Speed Approach effect	For drugs that are introduced in aqueous solutions		Often at the time of injection or in a few minutes
	through 10-20 minutes	through 10-15 minutes	
Strength of medication	2-3 times higher than with per os		5-10 times higher than for per os
Duration	Less than entering per os		Less than subcutaneous and intra-muscular type
Solubility product	Mandatory	Optional	Mandatory
Solvent	Water, sometimes oil	Water, sometimes oil	Water
Sterility of the preparation and aseptic introduction	Mandatory		
Absence of irritating effect	Mandatory	Preferred	Preferred

Steps to Medication Administration

Physicians and pharmacists should remember that the right choice of dose, route of introduction of drugs, application of preparations' etiotropic, pathogenetic, symptomatic action - the important condition of pharmacotherapy of any disease.



Steps to Medication Administration

- Select Proper Medication
  - Avoid contamination
  - Check Expiration Date
  - Check For Signs of Contamination
    - Discoloration
    - Cloudiness
    - Particulate Matter



Steps to Medication Administration

- Verify Form & Route
- Inform Patient of Order
  - Inquire about allergies
- Recheck Medication
  - Expiration date
  - Contamination
  - At least two more times after initial check



Thank you!