PHARMACOLOGY
TEAM 439

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MED439
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Drug administration and absorption

If you didn't understand any part from this lecture Click here!

- Important
- In male and female slides
- Only in male slides
- Only in female slides
- Extra information

Objectives

- Know the meaning of pharmacology and its branches.
- Discuss the different routes of drug administration.
- Identify the advantages and disadvantages of various routes of drug administration.
- Know the various mechanisms of drug absorption.
- List different factors affecting drug absorption.
- Define bioavailability and factors affecting it.

Any Future corrections will be posted on the editing file.
make sure to check it **frequently**

Click Here

Pharma : drug
Logos : science

Pharmacology

Definition

Is the science that deals with the drugs regarding names, pharmacokinetics, pharmacodynamics. side effects and therapeutic uses

Also defined as the study of how chemical agents affect living processes e.g. hormones, neurotransmitters & drugs.

Divided into

Pharmacokinetics

Are studies of **ADME**,
absorption, (moving the drug to the blood)
distribution
metabolism (mainly by the **liver**)
excretion of drugs (mainly by the **kidneys**)

(What the body does to a drug)

Pharmacodynamics

Are studies of :

- Mechanisms of drug action
- Pharmacological effects of drugs

(what the drug does to the body)

Drugs

Examples

- Acetylsalicylic (ASA) or Aspirin can reduce inflammation, pain & fever, it inhibits the action of a human cell membrane enzyme known as cyclooxygenase
- Penicillin cures certain bacterial infections, disrupts the synthesis of cell walls in susceptible bacterial strains by inhibiting a key enzyme

Routes

- Enteral via gastrointestinal tract (GIT) (Oral , Sublingual , Rectal)
- Parenteral administration = injections
- Topical application
- Inhalation

we have different routes of administration to:
1- choose the rate of absorption
2-avoid a root if it has a problem or obstruction

Pharmacokinetics

Bioavailability

Definition

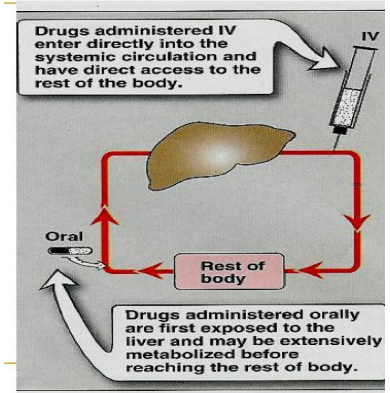
Is the amount of unchanged drug that enters systemic circulation after administration and becomes available to produce pharmacological actions

Drugs

Bioavailability

First pass effect

- Drugs given orally
- Taken to the liver (via portal circulation) and metabolized
- Reaching to the blood to be distributed to the body compartment



First pass metabolism

Occurs in

- Liver
- GIT wall
- GIT lumen

Results in

- Low bioavailability (low conc. Of drug in blood)
- Short duration of action (t ½)
- Drugs with high first pass effect should not be given orally but parenterally

oral administration
Through the mouth

Oral dosage forms	Tablets 	Coated tablets: Sugar-coated to mask bad taste.
		Enteric coated tablets: dissolve only in intestine
	Capsules	Hard gelatin capsules: contain **Powder** 
		Soft gelatin Capsules: contain **liquid** 
	Syrup 	e.g. Cough Syrup
	Suspension	Mixture of solid in liquids e.g. antibiotics
Advantages	• Common • Easy • Self use • Convenient • Cheap • No need for sterilization	
Disadvantages	• Slow effect, GIT irritation • Destruction by pH & enzymes e.g. penicillin, insulin • Food - drug interactions • Drug - drug interactions • First pass effect • No complete absorption • Low bioavailability • **Not suitable for :** -vomiting & unconscious patient -Emergency & bad taste drugs	

Sublingual administration Under the tongue	Advantages	• Rapid effect • Can be used in emergency • High bioavailability • No first pass effect • No GIT irritation • No food drug - interaction • **Dosage form :** friable tablet
	Disadvantages	• **Not suitable for :** - Irritant drugs frequent use
Rectal administration	Advantages	• Children, Vomiting, Unconscious patients • Irritant & bad taste drugs • Less first pass metabolism **(50%)** • **Dosage form :** suppository or enema
	Disadvantages	• Irritation of rectal mucosa • Irregular absorption & bioavailability

Parenteral administration Injection through the body	Advantages			• No Gastric irritation • No food drug interaction • No drug drug interaction • NO first pass metabolism • Higher availability than oral
	disadvantages			• Need skills • Pain, tissue necrosis or abscess (I.M.) • Anaphylactic (hypersensitivity) reaction (I.V.)
	types	Intradermal (I.D.) into skin	advantages	• Minute volume of drug (0.1 ml) • Suitable for vaccination • Sensitivity test
			Disadvantages	• **Not suitable for:** large volumes
		Subcutaneous (S.C,) Under skin	advantages	• volume of drug (0.1 - 1 ml) • Used for sustained release effect • Suitable for poorly soluble Suspensions and for instillation of slow-release implants e.g. Insulin Zinc preparation.
			disadvantages	• **Not suitable for:** large volumes
		Intramuscular (I.M) Into muscles	advantages	• Moderate volume (3-5 ml) • Prolonged (long duration) duration of action • Oily preparations or poorly soluble substances.
			disadvantages	**Not suitable for:** • Irritant drugs • Pain, abscess, tissue necrosis may happen.

Parenteral administration	types	Intravenous (I.V.)Into veins	advantages	• large volume (500ml can be given by infusion) • Rapid action (emergency) • High bioavailability • No food drug interaction • No first pass metabolism • No gastric irritation **Suitable for:** • Vomiting & Unconscious • Irritant & bad taste drugs.
			disadvantages	• Used only for water soluble drugs • Inficetion • Anaphylaxis • Sterilization • Eepensive **Not Suitable for:** • Oily solutions • poorly soluble substance  **Ampoule** Single use  **Vial** Repeated use
		Intra-arterial (I.A.)	in the artery	
		Intrathecal (I.T.)	Cerebrospinal fluids	
		Intraperitoneal (I.P.)	Peritoneal cavity= in abdominal area	
		Intra-articular Synovial fluids	داخل المفصل	

Topical application

definition: Drugs that are mainly applied topically to produce local effects

applied to:

Skin (Percutaneous)	e.g. Allergy test, topical antibacterial and steroids and local anesthetics.
Eye drops	e.g. Conjunctivitis
Ear drops	e.g. Otitis Externa
Intranasal	e.g. Decongestant nasal spray
Inhalation	(Mucous membrane of respiratory tract) e.g. Asthma

Inhalation

Advantages	• Rapid absorption, due to the large surface area • Suitable for emergency • Provide local action • Limited systemic effect • Less side effects • NO first pass effect.
Disadvantages	• **Not suitable for:** irritant drugs • Only few drugs can be used.
Dosage form	• Volatile gases e.g. anesthetics • Liquids giving by aerosol, nebulizer/inhaler for asthma treatment.

Transdermal patch:

Medicated adhesive patch applied to skin to provide systemic effect (prolonged drug action).

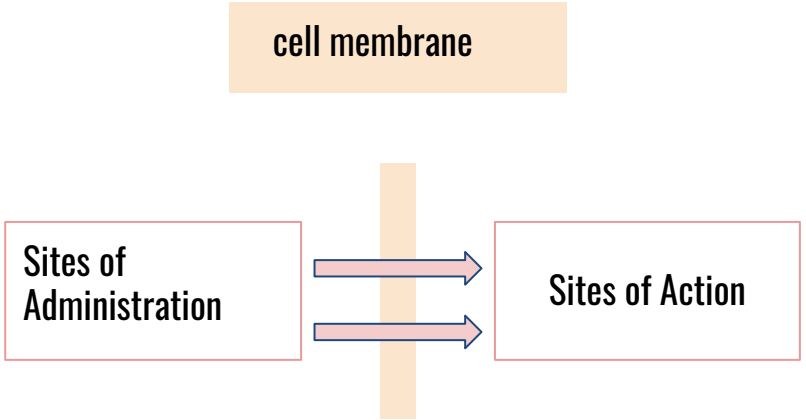
e.g. The nicotine patches (Quit smoking)
e.g. Scopolamine (vestibular depressant, antiemetic (مضاد للقيء) for motion sickness)

Drug Absorption

DEFINITION: the passage(transport) of drug from its site of administration to site of action across cell membranes.

EXCEPTION: **Except for intravenous administration**, all routes of drug administration require that the drug be absorbed from the site of administration into the systemic circulation (blood)

- I.V. administration requires no absorption (because they are delivered directly into the bloodstream)



Mechanisms of Drug Absorption:

The transport of drugs across cell membrane occurs through one or more of the following processes:

- **Simple diffusion (passive diffusion)**
  - **Aqueous diffusion** — low molecular weight & water soluble drugs diffuse through aqueous channels or pores in cell membrane (filtration)
  - **Lipid diffusion** — low molecular weight & lipid soluble drugs diffuse through lipid cell membrane.
- **Facilitated diffusion**
- **Active transport**
- **Phagocytosis**
  - **Exocytosis** — expulsion of membrane bound particles.
  - **Endocytosis (pinocytosis)** — uptake of membrane bound particles.

phagocytosis occurs for drugs which are either:

-**high molecular weight** e.g peptides

-**high polar drugs** e.g vitamin B12 & iron

vitamin B12 combines with intrinsic factor.

IRON combines with transferrin.

Passive Diffusion	Active Diffusion If the mechanism requires a **carrier**, it's also **saturable** and **specific**	Facilitated Diffusion (Carrier mediated)
ALONG(with) Concentration Gradient from rich to poor high to low	AGAINST Concentration Gradient low to high	ALONG Concentration Gradient high to low
No Energy & Carrier	Requires Energy & Carrier	No Energy But Requires Carrier
Common	Uncommon	———————-
Not Saturable	Saturable	Saturable
Non Selective	Selective (Specific)	Selective
DEPENDS ON Lipid Solubility (drugs which are lipophilic are easily cross membrane)	E.G. Absorption Of Sugar &Amino Acid	E.G. Similar To Entry Of Glucose Int Muscle (GLUT 4)
DEPENDS ON Pka Of Drug & PH Of The Environment (it can be fluid of the cell body, blood, urine)	Uptake Of Levodopa by Brain (levodopa is used in treatment of parkinsonism - الشلل الارتعاشي-)	————————

Effect of Pka & pH on Drug Absorption

pKa of the drug (dissociation or ionization constant): pH at which half of the substance is ionized & half is unionized.

- The lower the pKa value (pKa < 6) of the acidic drug, the stronger the acid, **e.g** Aspirin (Pka= 3.0)

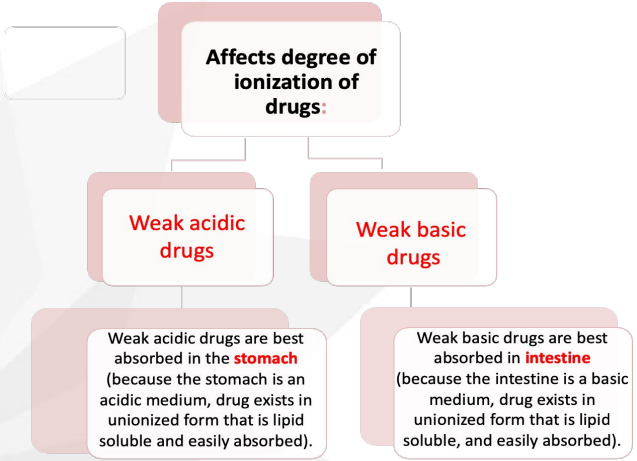
- The higher the pKa value (pKa >8) of a basic drug, the stronger the base, **e.g** propranolol(pKa= 9.4)

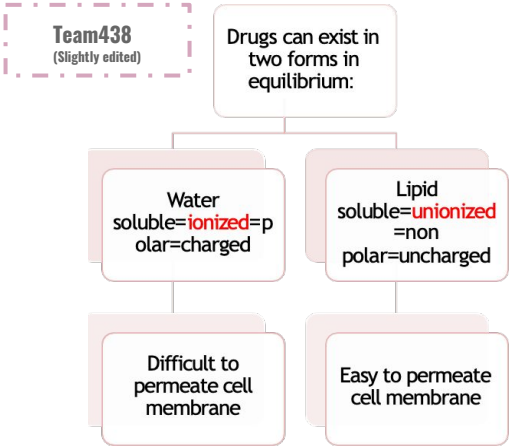
- Most drugs are weak acids or weak bases.
- Only unionized form is absorbable.
- Ionization of drugs reduce passage of drugs across cell membranes.
- The degree of ionization of drugs is determined by their Pka and pH of the surrounding .

pH is a measure of hydrogen ion concentration, a measure of the acidity or alkalinity of a solution.

pKa gives details of the dissociation of an acid in aqueous solution

team438: If an acidic drug entered a basic medium the drug will become ionized and the drug won't show its effect Same thing will happen if a basic drug entered an acidic medium





Factors affecting absorption ↑↓

1. **Route of administration**
   e.g; sublingual > oral
2. **Dosage forms**
   Depends on (particle size, ease of dissolution)
   (solution> suspension> capsule> tablet)
3. ↓ **molecular weight of drug** ↑
   small > big
4. ↑ **Lipid and drug solubility** ↑
   (aqueous preparation better than oily, suspension preparation)
5. ↑ **degree of ionization** ↓
   un-ionized > ionized
   (ionized mean it is polar (water soluble)
6. **chemical instability in gastric pH**
   Penicillin & insulin
7. ↑ **Surface area** ↑
   (**small intestine** has large surface area than stomach due to intestinal microvilli)
8. ↑ **blood flow to absorptive site** ↑
   (**greater** flow increases bioavailability) (intestine has greater flow than stomach)
9. ↑ **Intestinal motility** ↓
   (diarrhea reduces absorption)
10. ↑ **Gastric emptying** ↑
    drugs that increase gastric emptying **enhance** absorption (only for **basic** drugs) (it will **diminish** absorption of **acidic** drugs because they will move to the intestines)
11. **Drug interactions**
12. **Food**
    -**slow** gastric emptying
    -generally slow absorption.
    -Tetracycline, aspirin, penicillin V.
    -**fatty meal** increase the absorption fat soluble antifungal drug (e.g. griseofulvin)

Keys:

- Absorption
- Factors affecting absorption

↑ increase
↓ decrease

MCQ

1) What is the most common way of drug administration ?

A) Oral	B) Sublingual	C) IV (intravenous)	D) IT (intrathecal)

2) Pharmacokinetic of drugs are studies of drugs regarding ?

A) AMDE	B) ADME	C) MADE	D) EMDA

3) Vial is a vessel or a battle for a?

A) Single use	B) Double use	C) Repeated use	D) None

4) Which type of drug administration has the highest bioavailability?

A) Rectal	B) Oral	C) IV (Intravenous)	D) IA (Intra-arterial)

ANSWERS

1	A
2	B
3	C
4	C

MCQ

5) Which route of administration does not require absorption ?

A) I.V.	B) I.D.	C) I.M.	D) I.T.

6) Acidic drugs are best absorbed in?

A) Liver	B) Intestine	C) Stomach	D) Urinary bladder

7) Which of the following is not absorption affecting factor?

A) food	B) surface area	C) age	D) intestinal motility

8) Which of the following will be best absorbed in stomach where pH is around (1-2)?

A) aspirin	B) propranolol	C) A & B	D) none of them

ANSWERS

5	A
6	C
7	C
8	A

MCQ

9) Which mechanism requires a carrier?			
A) simple diffusion	B) active transport	C) facilitated diffusion	D) B&C

10) Where does the first pass effect take place?			
A) Lymph nodes	B) Liver	C)Kidney	D) Spleen

11) Why are transdermal patches usually used?			
A) Better absorption	B) Higher volume	C) Rapid effect	D) Prolonged drug action

12) Where is the best absorption site for drugs which are taken orally* ?			
A) stomach	B) blood	C) small intestines	D) none of them

ANSWERS

9	D
10	B
11	D
12	C

*12- if they don't specify the drug. the answer will depend on the surface area

GOOD LUCK!

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Special thanks to 2nd year's micro team leader .. the amazing .. !!!
(Ghada Alsadhan)

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- نورة الدخيل
- اسيل الشهري
- الجوهرة البنيان
- شادن العبيد
- سديم آل زايد
- روان باقادر
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