PHARMACOLOGY

Drug Administration And Absorption

OBJECTIVE:

- 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.

Pharmacology

A science that deals with the drugs regarding classification, pharmacokinetics, pharmacodynamics, side effects and uses.

Pharmacokinetics:
(what the body does to a drug?)

Pharmacodynamics
(what the drug does to the body?)

Pharmacodynamics:

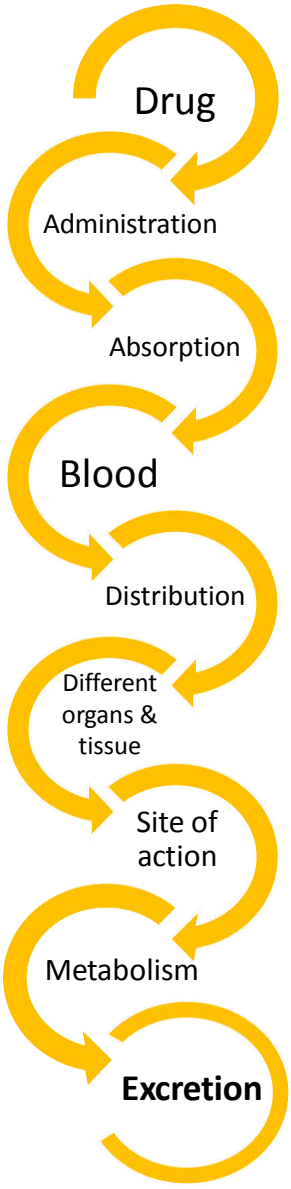
1. **Mechanismsof drug action**
2. **Pharmacological effects of drugs**

Pharmacokinetics(ADME) :

- **Absorption**
- **Distribution**
- **Metabolism**
- **Excretion**

Routes of drug administration:

1. **Enteral**(Oral –Sublingual –Rectal)
2. **Inhalation**
3. **Parenteral**(Injections)
4. **Topical application**



Routes of drug administration:

1- Enteral via gastrointestinal tract (GIT):

	Advantage	Disadvantage
Oral	• Common • Easy • Self use • convenient • cheap • No need for sterilization.	• Slow effect, GIT irritation. • Destruction by pH and enzymes. • Food - drug interactions. • Drug-drug interactions. • First pass effect. • No complete absorption. • Low bioavailability. • Not suitable for vomiting and unconscious patient and emergency and bad taste drugs.
Sublingual	• Rapid effect • can be used in emergency • High bioavailability • No first pass effect. • No GIT irritation • No food drug – interaction • Dosage form: friable tablet (easily breaks and dissolves)	• not suitable for : Irritant drugs Frequent use
Rectal	• Suitable for • children, vomiting, unconscious patients • Irritant & bad taste drugs • less first pass metabolism (50%) • Dosage form suppository or enema	• Irritation of rectal mucosa • Irregular absorption & bioavailability

First pass effect:

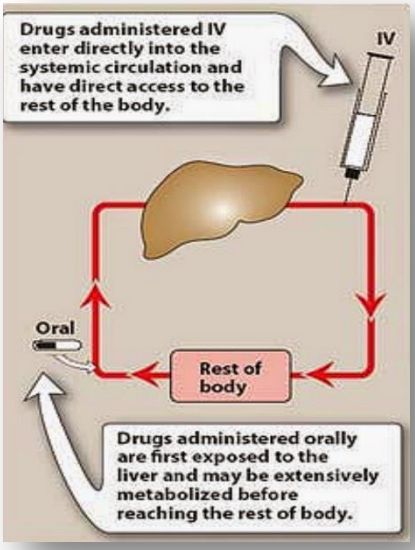
Drugs given orally → via portal circulation → taken to the liver and metabolized → reaching to the blood to be distributed to body compartments

First pass metabolism results:

- **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.

Where it occur:

- Liver (mainly).
- Gut Wall.
- IT Lumen.



Oral Dosage Forms "oral formulations":

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: (contains liquid)

Syrup: (e.g. Cough syrups)

Suspension: **"mixture of solid in liquids"** e.g. antibiotics

Routes of drug administration:

2- Inhalation:

	Advantage	Disadvantage
Inhalation	• Rapid absorption (due to large surface area) • Immediate Effects • limited systemic effect • Ideal For Gases • Effective • Local Effect • Dose Can Be Titrated • Suitable For Emergency • Fewer Side Effects	• addictive route • patients may have difficulty using inhalers • patients may have difficulty regulating dose • Not suitable for irritant drugs • Only few drugs can be used

3- Parenteral (injection):

	Advantage	Disadvantage
Parenteral	• No first-pass metabolism • Have Highest Bioavailability • No food-drug / drug-drug interaction • No gastric irritation	• Need skill • Pain, tissue necrosis or abscess (I.M) • Anaphylactic reaction (I.V)

Type of Parenteral:

Intradermal (I.D) **(into skin)**	**Subcutaneous** (S.C) **(Under skin)**	**Intramuscular** (I.M) **(into muscle)**	**Intravenous** (I.V) **(into veins)**
Intra-arterial (I.A) **(into arteries)**	**Intrathecal** (I.T) **(cerebrospinal fluids)**	**Intraperitoneal** (I.P) **(peritoneal cavity)**	**Intra-articular (Synovial fluids)**

Parentral

	Advantage	Disadvantage	Volume
Intradermal (I.D)	• suitable for vaccinations • sensitivity test	• Not suitable for large volumes.	**0.1 ml**
Subcutaneous (S.C)	• Used for sustained release effect • Suitable to poorly soluble & suspensions & for Instillation of slow-release implants e.g. insulin zinc preparation	• Not suitable for large volumes	**0.1ml –1ml**
Intramuscular (I.M)	• prolonged duration of action • oily preparations or poorly soluble substances can be used	• Not suitable for irritant drugs • pain, abscess, tissue necrosis may happen	**3-5ml**
Intravenous (I.V)	• Large volume • Rapid action (emergency) • High bioavailability • No food-drug interaction • No first pass metabolism • No gastric irritation • Suitable for Vomiting, unconscious ,Irritant & bad taste drugs.	• used only for water soluble drugs • Infection • Anaphylaxis • Sterilization • Expensive • Not suitable for oily solutions or poorly soluble substance • Must inject solutions slowly as a rule	**500ml**

4- Topical application

Drugs are mainly applied topically to produce local effects. They are applied to

- Skin (percutaneous) e.g. allergy test, topical antibacterial and steroids and local anesthetics.
- Mucous membrane of respiratory tract (Inhalation) e.g. asthma
- Eye drops e.g. conjunctivitis
- Ear drops e.g. otitis externa
- Intranasal e.g. decongestant nasal spray

Transdermal patch:

Is a medicated adhesive patch that is placed on the skin to deliver a specific dose of medication through the skin and into the bloodstream. Girl's definition: are 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 for motion sickness).

Ampoule (single use)

Vial (repeated use)

(Parenteral Dosage Forms)

Atomizer

Nebulizer

(Inhalation Dosage Forms)

Drug Absorption

DEFINITION: the passage of drug from it's 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 transported from the site of administration into the systemic circulation. (I.V. administration requires no absorption)

Mechanisms of drug absorption:

- Simple diffusion(passive diffusion):

  Aqueous diffusion: low molecular weight through aqueous channel or pores in cell membrane (filtration)

  Lipid diffusion: low molecular weight & lipid soluble drugs through lipid cell membrane
- Facilitated diffusion
- Active transport
- Pinocytosis(Endocytosis):

  - for high molecular weight drugs such as peptides

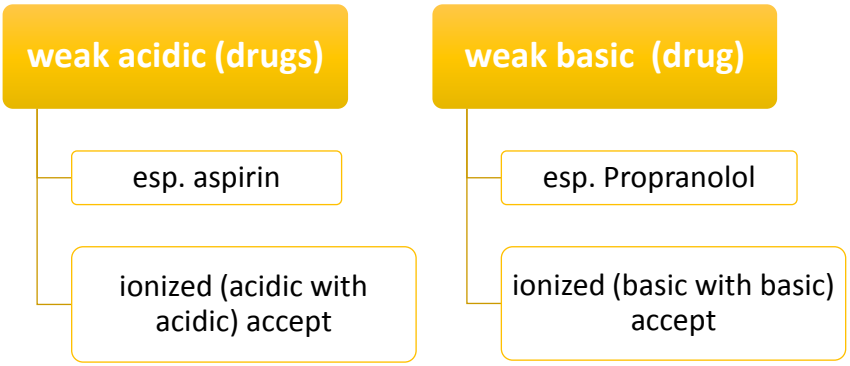
  - high polar substances such as vitamin B12(combines with intrinsic factor) &iron (combines with transferrin)

Passive Diffusion	Active Diffusion	Facilitated Diffusion
ALONG Concentration Gradient	AGAINST Concentration Gradient	ALONG Concentration Gradient
No Energy & Carrier	Requires Energy & Carrier	No Energy But Requires Carrier
Common	Uncommon	_____
Not Saturable	Saturable	Saturable
Non Selective	Selective (Specific)	Selective
DEPEND ON Lipid Solubility	E.G. Absorption Of Sugar & Amino Acid	E.G. Similar To Entry Of Glucose Into Muscle
DEPEND ON Pka Of Drug & PH Of The Environment	Uptake Of Levodopa* By Brain	_____

(It can be fluid of the cell body, blood, urine)

Pka and PH effect drug

Pka effect & PH:



Note :

- **Drugs can exist in 2 forms in equilibrium** : ionized (water soluble)
  unionized (lipid soluble)
- Only UNIONIZED form is absorbable
- Ionization of drugs reduces passage of drugs across cell membrane
- The degree of ionization of drugs is determined by their pKa and pH surrounding
- 50% of the drugs will be unionized and 50% of the drugs will be ionized.
- Basic drugs are best absorbed in the intestine
- Acidic drugs are best absorbed in the stomach

Factors affecting absorption:

Route of administration	**Dosage forms** (particle size, ease of dissolution) (solution > suspension > capsule > tablet)	**Molecular weight of drug**
Lipid and drug solubility (aqueous preparation better than oily, suspension preparation)	**Degree of ionization**	**Chemical instability in gastric pH**
Surface area available for absorption (small intestine has large surface area than stomach due to intestinal microvilli)	**Blood flow to absorptive site** (greater blood flow increases bioavailability) (intestine has greater blood flow than stomach)	**Intestinal motility (transit time)** (Diarrhea reduces absorption)
Gastric emptying (drugs that increase gastric emptying enhance absorption (metoclopramide))	**Drug interactions**	**Food** (Slow gastric emptying, generally slow absorption) (A fatty meal increases the absorption of fat soluble antifungal drug (e.g. griseofulvin))

THANK YOU FOR CHECKING OUR WORK

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