Routes of Drug Administration

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Routes of Drug Administration

A. Enteral
B. Parenteral
C. Others

A. Enteral Routes

1. **Oral route (PO):**

- **The drug should be swallowed.**
- **Most commonly used route.**
- **Safest, most convenient, and most economical**
- **Duodenum is the major site of absorption, but other parts of GIT may be involved.**

A. Enteral Routes

Disadvantages:

a. **The patient must be cooperative (compliant).**
b. **Absorption is variable because of several factors affecting the rate and extent of absorption:**

- **Vomiting**
- **Failure of disintegration and dissolution**

A. Enteral Routes

- **First-pass effect**
- **Drug may be destroyed by gastric acid or intestinal flora.**
- **Food may delay absorption.**
- **Alteration in intestinal motility may affect absorption.**
- **Absorption may be affected by splanchnic blood flow.**

A. Enteral Routes

2. **Sublingual route (SL):**

- **Drug is placed under the tongue.**
- **Avoids first-pass effect.**
- **Used when a rapid onset is required – such as in angina pectoris.**
- **Not commonly used.**

A. Enteral Routes

3. **Rectal route (PR):**

- **Avoids first-pass effect partially (~ 50%). Why?**
- **Useful in unconscious or vomiting patients.**
- **Absorption is often irregular, incomplete and unpredictable.**
- **Can be used for a local effect.**

Table 13-1 Common Routes of Drug Administration

Route	Bioavailability	Advantages	Disadvantages
Parenteral Routes			
Intravenous bolus (IV)	Complete (100%) systemic drug absorption. Rate of bioavailability considered instantaneous.	Drug is given for immediate effect.	Increased chance for adverse reaction. Possible anaphylaxis.
Intravenous infusion (IV inf)	Complete (100%) systemic drug absorption. Rate of drug absorption controlled by infusion rate.	Plasma drug levels more precisely controlled. May inject large fluid volumes. May use drugs with poor lipid solubility and/or irritating drugs.	Requires skill in insertion of infusion set. Tissue damage at site of injection (infiltration, necrosis, or sterile abscess).
Subcutaneous injection (SC)	Prompt from aqueous solution. Slow absorption from repository formulations.	Generally, used for insulin injection.	Rate of drug absorption depends on blood flow and injection volume. Insulin formulaton can vary from short to intermediate and long acting.
Intradermal injection	Drug injected into surface area (dermal) of skin.	Often used for allergy and other diagnostic tests, such as tuberculosis.	Some discomfort at site of injection.
Intramuscular injection (IM)	Rapid from aqueous solution. Slow absorption from nonaqueous (oil) solutions.	Easier to inject than intravenous injection. Larger volumes may be used compared to subcutaneous solutions.	Irritating drugs may be very painful. Different rates of absorption depending on muscle group injected and blood flow.
Intra-arterial injection	100% of solution is absorbed.	Used in chemotherapy to target drug to organ.	Drug may also distribute to other tissues and organs in the body.
Intrathecal Injection	100% of solution is absorbed.	Drug is directly injected into cerebrospinal fluid (CSF) for uptake into brain.	
Intraperitoneal injection	In laboratory animals, (eg, rat) drug absorption resembles oral absorption.	Used more in small laboratory animals. Less common injection in humans. Used for renally impaired patients on peritoneal dialysis who develop peritonitis.	Drug absorption via mesenteric veins to liver, may have some hepatic clearance prior to systemic absorption.

B. Parenteral Routes

- **Used for drugs poorly absorbed from, or unstable in the GIT.**
- **Used for rapid effect.**
- **Aseptic technique is required.**

1. **Intravenous route (IV):**

- **Bolus vs infusion.**
- **Only aqueous solutions may be injected IV.**
- **Rapid onset of action.**

B. Parenteral Routes

- **Oily vehicles or those that precipitate blood constituents should not be given IV.**
- **No first-pass hepatic metabolism, the drug goes first to the right side of the heart, the lung, the left side of the heart, then to the systemic circulation.**

B. Parenteral Routes

Disadvantages:

1. **Produce high initial concentration of the drug that might be toxic.**
2. **Once injected, the drug is there…??**

B. Parenteral Routes

2. **Intramuscular route (IM):**

- **The drug is injected within muscle fibers of deltoid, gluteus maximus or vastus lateralis.**
- **Absorption of drug depends on blood supply (slower for g.m.**
- **Absorption is reduced in circulatory failure or shock.**

B. Parenteral Routes

- **To be injected IM, the drug must be non-irritating to tissues.**
- **Can utilize:**

a. **Aqueous solutions for fast absorption and rapid action.**

b. **Depot preparations and suspensions for slow or sustained absorption (oily vehicles or ethylene glycol).**

- **Can accommodate large volumes.**

B. Parenteral Routes

3. **Subcutaneous injections (SC, or SQ):**

- **The drug is injected under the skin.**
- **Absorption is affected by blood flow.**
- **Drug should be non-irritating to tissues.**
- **Absorption is slow and sustained.**
- **Accommodate smaller volumes than IM.**
- **Solid pellets can be implanted under the skin to produce effects over weeks-months.**

Other Routes

1. **Inhalational or pulmonary route:**

- **Used for gaseous or volatile drugs, such as general anesthetics.**
- **Can also be used for solids that can be put in an aerosol, such as drugs for bronchial asthma.**
- **Drugs are absorbed across pulmonary epithelium and mucous membranes of respiratory tract.**

Other Routes

- **Absorption is rapid.**
- **Avoids first-pass effect.**
- **The lung acts as a route of elimination also.**

Other Routes

2. **Topical application:**

- **For a local effect on:**

  a. mucous membranes: conjunctiva, nose, mouth, nasopharynx, oropharynx, vagina, rectum, colon, urethra, and urinary bladder.

  b. skin: highly lipid-soluble drugs can be absorbed systemically.

Other Routes

- **Systemic absorption also occurs from abraded, burned and inflamed skin.**

3. Transdermal route (TD):

- **The drug is applied to the skin for systemic effect, such as in angina.**
- **For a sustained effect.**
- **Avoids first-pass metabolism.**

Enteral Routes			
Buccal or sublingual (SL)	Rapid absorption from lipid-soluble drugs.	No "first-pass" effects. Buccal route may be formulated for local prolonged action. Eg, adhere to the buccal mucosa with some antifungal. Buccal is different from sublingual which is usually placed "under tongue."	Some drugs may be swallowed. Not for most drugs or drugs with high doses.
Oral (PO)	Absorption may vary. Generally, slower absorption rate compared to IV bolus or IM injection.	Safest and easiest route of drug administration. May use immediate-release and modified-release drug products.	Some drugs may have erratic absorption, be unstable in the gastointestinal tract, or be metabolized by liver prior to systemic absorption.
Rectal (PR)	Absorption may vary from suppository. More reliable absorption from enema (solution).	Useful when patient cannot swallow medication. Used for local and systemic effects.	Absorption may be erratic. Suppository may migrate to different position. Some patient discomfort.
Other Routes			
Transdermal	Slow absorption, rate may vary. Increased absorption with occlusive dressing.	Transdermal delivery system (patch) is easy to use. Used for lipid-soluble drugs with low dose and low MW (molecular weight).	Some irritation by patch or drug. Permeability of skin variable with condition, anatomic site, age, and gender. Type of cream or ointment base affects drug release and absorption.
Inhalation and intranasal	Rapid absorption. Total dose absorbed is variable.	May be used for local or systemic effects.	Particle size of drug determines anatomic placement in respiratory tract. May stimulate cough reflex. Some drug may be swallowed.