

Routes of Administration of Drugs

Dr. javaid Nazir



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Routes of Drug Delivery

**Parenteral
(IV)**



Inhaled



Oral



Transdermal



**Parenteral
(SC, IM)**

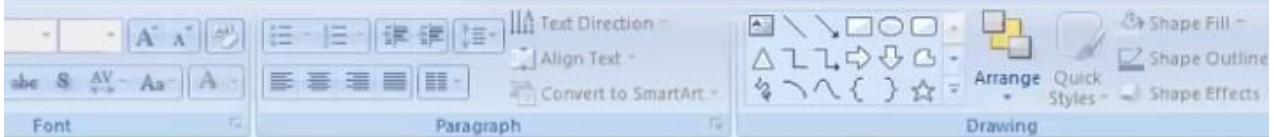


Topical



Rectal



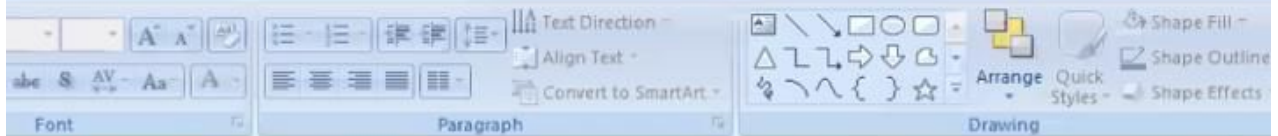


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The route of administration of drug depends upon

1. physical & chemical properties of drug
2. site of desired action.
3. seriousness & urgency of disease.
4. condition of the patient.

ROA influences the onset of action, duration of action & intensity of action of a drug. Whatever may be the ROA, drugs may produce their pharmacological effect either by local, systemic or reflex action.

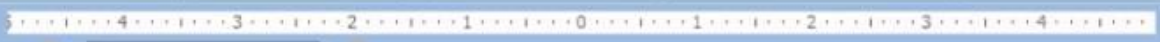
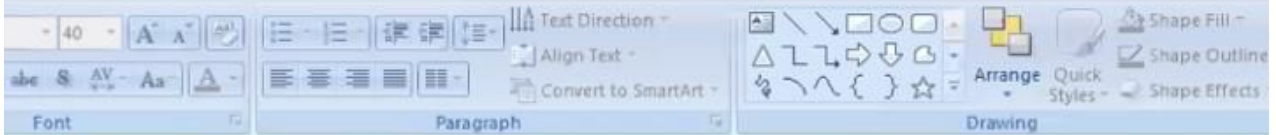


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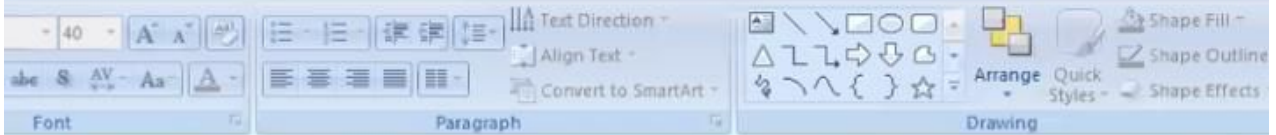
Various Routes of Administration

The possible routes of administration are divided broadly into three classes

1. Enteral
2. Parenteral
3. Topical including inhalation route.



**ENTERAL
ROUTE**
**means through
alimentary tract**



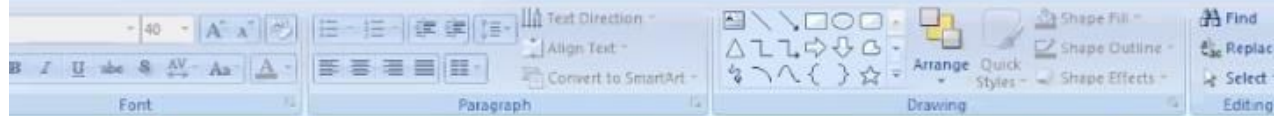
➤ Oral

➤ Sublingual or Buccal

➤ Rectal

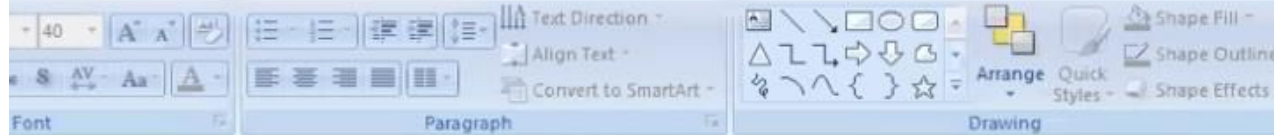


- Natural route. It is the most commonly used method of drug administration.
- Has the advantage of ease & safety.
- Majority of drugs given orally absorbed from small intestine. Few are absorbed from stomach & colon.
- As compared to inj., onset of action after oral administration is slow but duration of action is prolonged.
- If given on empty stomach, absorption will be quick.



a. Enteric-coated preparations: An enteric coating is a chemical envelope that protects the drug from stomach acid, delivering it instead to the less acidic intestine, where the coating dissolves & releases the drug. Enteric coating is useful for certain drugs (eg omeprazole) that are acid unstable. Drugs that are irritating to the stomach, such as aspirin, can be formulated with an enteric coating that only dissolves in the s. intestine thereby protecting the stomach.

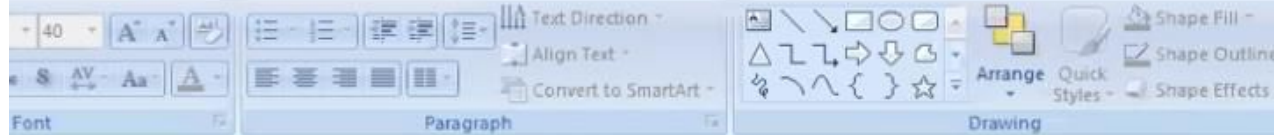
b. Extended-release preparations: Extended-release (abbreviated ER or XR) medications have special coatings or ingredients that control



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the drug release, thereby allowing for slower absorption & a prolonged duration of action. ER formulations can be dosed less frequently and may improve patient compliance.

- Additionally, ER formulations may maintain concentrations within the therapeutic range over a longer period of time, as opposed to immediate-release dosage forms, which may result in larger peaks and troughs in plasma concentration. ER formulations are advantageous for drugs with short $t_{1/2}$ eg the $t_{1/2}$ of oral *morphine* is 2 to 4 hours & it must be administered six times daily to provide



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continuous pain relief. However, only two doses are needed when extended release tablets are used. Unfortunately, many ER formulations have been developed solely for a marketing advantage over immediate-release products, rather than a documented clinical advantage.

Advantages of oral route: **1. Safest**

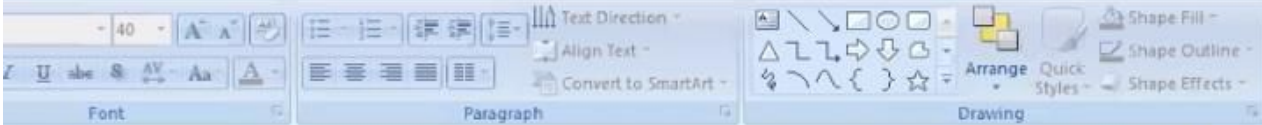
2. most convenient

3. most economical route

4. Natural

5. Suitable for self administration.

6. Large area is available for absorption.



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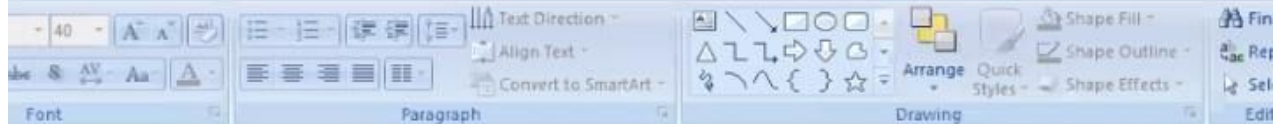
2. most convenient

3. most economical route

4. Natural

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DISADVANTAGES:

- **Some drugs may not be absorbed at all eg streptomycin, neomycin.**
- **Drugs may be irritant to gastric mucosa to cause nausea & vomiting.**
- **Destruction of drugs by digestive enzymes eg insulin, adrenaline, benzyl penicillin etc. (First pass effect).**



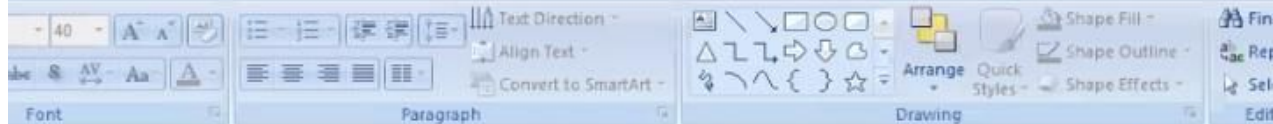
- **Irregular absorption due to various factors.**
- **Patient cooperation needed.**
- **Discoloration of teeth may occur eg iron mixtures.**
- **Slow onset of action.**
- **Unpleasant & bitter taste or odor eg quinine.**
- **Cannot be used in unconscious patients.**
- **Unsuitable in emergency situations.**



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Examples:

- **Tablets:
(Antibiotics, Analgesics etc)**
- **Syrups in different forms**



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Sublingual / Buccal:

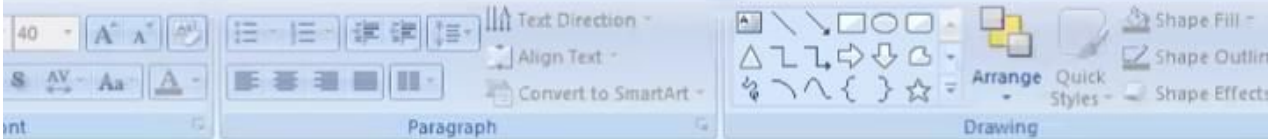
- Tablet is placed under the tongue or between the cheek & gingiva.
- Tab. dissolves rapidly & drug is absorbed quickly & directly into blood stream avoiding the initial passage through liver i.e. avoiding 1st pass effect (**enter the systemic circulation through the sublingual vessels**).
- **Pt is advised to keep saliva in the mouth to facilitate absorption.**
- **Relatively few drugs are given by this route.**



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Advantages:

- **Rapid absorption**
- **Drug stability**
- **Drugs are very potent and few molecules need to be absorbed to produce therapeutic effects**
- **Drainage is through superior vena-cava.**
- **Protected from rapid first pass metabolism**

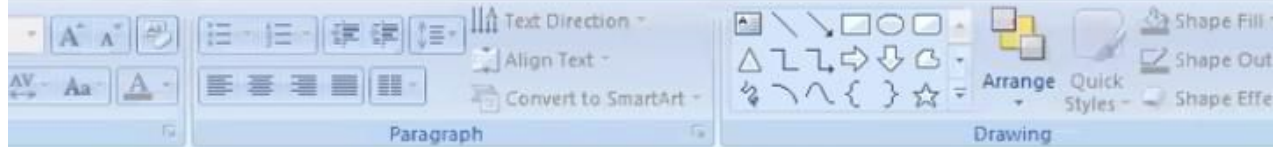


Slides Outline

- 18 **Sublingual / Buccal**
 - Placed in buccal pouch or the space between the gum & cheek
 - The mucosa is thin & has a rich blood supply & directly into blood stream using the capillary network through the mucosa (bypasses the liver)
 - Also suitable for drugs which do not irritate the oral mucosa
 - Relatively few drugs are given by this route
- 19 **Advantages**
 - Rapid absorption
 - High stability
 - Bypasses first pass effect & metabolism in the liver
 - Relatively simple to administer
 - Portable form, useful for pain relief
- 20 **Disadvantages**
 - Limited drugs can be given
 - May be unpleasant in taste
 - Large doses may not be given
 - Oral cavity integrity largely affects absorption
 - Patient cooperation needed
- 21 **Example**
 - Nitroglycerin for angina
 - Ergometrin for migraine
 - Fentanyl patches for pain relief
 - Insulin for diabetes

Disadvantages:

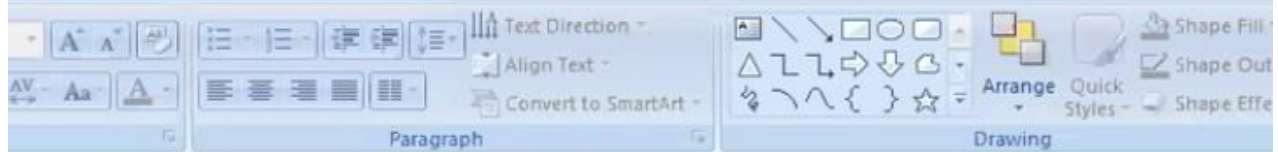
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Examples:

- **Nitroglycerine** for angina
- **Isoprenaline** for asthma
- **Certain steroids eg methyltestosterone.**
- **oxytocin** sometimes.

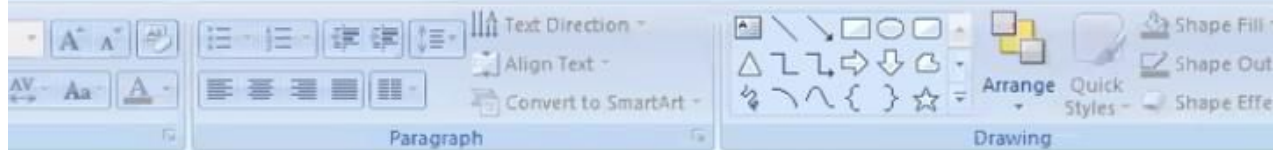




Rectal Route:

Drugs may be sometimes placed in the rectum in the form of

- Suppositories if drugs are in solid form
- Enema if they are in liquid form.
- Drugs given per rectally may have local action or systemic action after absorption.
- Drugs are given rectally when pt is either unconscious or cannot retain drug when administered orally.
- Drugs are absorbed more slowly from rectum than from small intestine.



- Effect of digestive enzymes on drug is avoided in this route.

Hepatic 1st pass effect can be avoided to a great extent by use of S/L & transdermal route & to a lesser extent by use of rectal suppositories.

IMPORTANT: Drugs absorbed from suppositories in the lower rectum carried by middle & inferior haemorrhoidal veins into inferior vena cava thus bypassing liver so avoid 1st pass effect. However suppository that moves upward in the rectum carried by superior haemorrhoidal vein to the portal circulation so can undergo 1st pass effect & so only 50% of a rectal dose can be assumed to bypass the liver.



Slides Outline

- 25 **Advantages:**
 - This route can be used in unconscious patients, elderly or young children.
 - Nauseous or vomiting patients
 - Good for drugs affecting the bowel (laxatives)
 - 50% of the absorbed drugs bypass hepatic first pass metabolism.
- 26 **Disadvantages:**
 - Drugs are absorbed more slowly than when they have small intestine for the site of absorption because the drug is diluted in the rectum.
 - Not a readily used route.
 - Irregular and incomplete absorption.
 - Many drugs may cause irritation of rectal mucosa.
 - Good for substances for the rectum.
- 27 **Examples of drugs given PR**
 - 1) Suppositories for local action:
 - Glucocorticoids (prednisolone)
 - Nausea (metoclopramide)
 - 2) Suppositories for general action:
 - Analgesics (paracetamol)
 - Sedatives (diazepam)
- 28 **Rectal Administration**
 - **Rectal Administration** is used to avoid the stomach and first pass effect. It is used for unconscious patients, elderly children, and patients who are unable to take oral medicine. The drug is absorbed in the rectum and bypasses hepatic first pass metabolism.
 - **Rectal Administration** is also used for the treatment of hemorrhoids and other rectal conditions.

Advantages:

- This route can be used in **unconscious patients, elderly or young children.**
- **Nauseous or vomiting patients**
- **Good for drugs affecting the bowel (laxatives)**
- **50% of the absorbed drugs bypasses hepatic first pass metabolism.**

2 - Route of Administration | [Compatibility Mode] - Microsoft PowerPoint

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Clipboard: Cut, Copy, Paste, Format Painter

Slides: New Slide, Revert, Delete

Font: Font size (32), Bold, Italic, Underline, Paragraph: Text Direction, Align Text, Convert to SmartArt

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Slides Outline

26 **Rectal route**

- Drugs are absorbed more slowly than when they are given orally. For the effect of absorption, drugs are drugs to a certain extent.
- Not a routinely used route.
- Irregular and incomplete absorption.
- Many drugs may cause irritation of rectal mucosa.
- Could be embarrassing for the patient.

27 **Examples of Rectal Route**

- Suppositories for local action: Glycine suppositories, Hemorrhoid suppositories.
- Suppositories for systemic action: Acetylsalicylic acid, Sulfonamides.
- Some Enemas

28 **Rectal route: administration of a drug in a suppository**

- **INDICATIONS:** In order to avoid the first pass effect of a drug when administered orally.
- **ADVANTAGES:** Easy to administer, no need for needles or syringes, no pain, no risk of infection, no risk of allergic reaction, no risk of drug abuse, no risk of drug dependence, no risk of drug addiction.
- **DISADVANTAGES:** Drug administration with suppositories is not as effective as oral administration. The drug is not absorbed as quickly as when administered orally.

29 **Parenteral Routes**

- Administration of drugs by routes other than enteral (oral) is called parenteral administration. In practice, it refers to administration of drugs by injection.
- **Advantages of IV:**
 1. Rapid onset of action and immediate effect.
 2. Precise dosage is possible.
 3. Parenteral therapy is useful where oral administration is not possible or when the drug is not absorbed by mouth.
 4. They are not affected by GI tract administration.

Disadvantages:

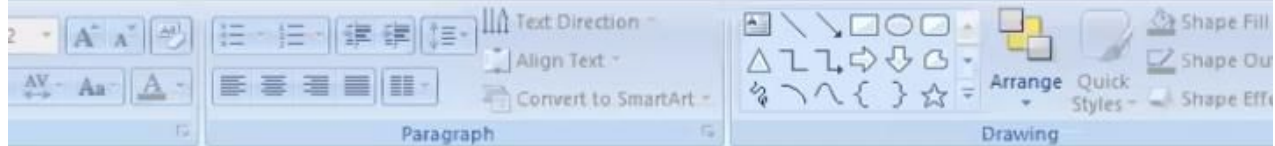
- **Drugs are absorbed more slowly from rectum than from small intestine but the effect of digestive enzymes on drugs is avoided in this route.**
- **Not a routinely used route.**
- **Irregular and incomplete absorption.**
- **Many drugs may cause irritation of rectal mucosa.**
- **Could be embarrassing for the patient.**

Slides Outline

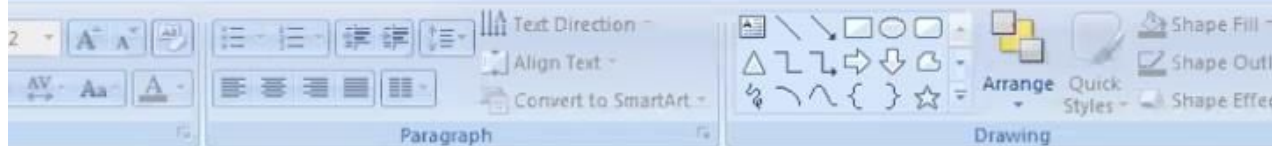
- 18 **Local Routes**
 - Things are absorbed more slowly than routes that have small surface area for effect of absorption because no drugs are absorbed in the mouth.
 - Not a readily used route
 - Irregular and incomplete absorption
 - Many drugs may cause irritation of oral mucosa
 - Good for enter coating for the product
- 27 **Examples of Rectal P/R**
 - Suppositories for local action: Glycerin Suppository, Benzocaine suppository
 - Suppositories for systemic action: Aminophylline, Indomethacin
 - Barium Enema
- 28 **Rectal P/R**
 - Rectal P/R is administration of a drug in a liquid form into rectum, sigmoid flex or
 - PAINKILLER SUPPOSITORIES** are used to relieve the patient with mild to moderate pain. They are given rectally to avoid side effects of drugs like vomiting, dizziness, headache & respiratory depression of oral.
 - ANTHELMINTIC SUPPOSITORIES** Drug administered with about 10% oil of thymol. It is absorbed in the rectum for local activity and systemic action for intestinal worms.
- 29 **Parenteral Routes**
 - Administration of drugs by routes other than enteral route is called parenteral administration. In practice, it refers to administration of drugs by injection.
 - Advantages of IV:
 - 1. Rapid onset & predictable action since drug goes directly into blood.
 - 2. Parenteral therapy is useful where oral is not possible, absorption is unable to absorb the drug given by mouth.
 - 3. They are not affected by GI tract or metabolism.

Examples of drugs given P/R:

- Suppository for local action:**
Glycerin Suppository,
Bisacodyl suppository
- Suppositories for systemic action:**
Aminophylline, Indomethacin.
- Barium Enema**



- **ENEMA** is administration of a drug in a liquid form into rectum. Enema may be
- **EVACUANT ENEMA:** In order to empty the bowel, 600 mls of soap water is administered per rectum. Water distends & so stimulates the rectum while soap lubricates. **This type of enema is given prior to surgeries, obstetric procedures & radiological examinations of gut.**
- **RETENTION ENEMA:** Drug administered with about 100 ml of fluids & is retained in the rectum for local action eg prednisolone enema for ulcerative colitis.

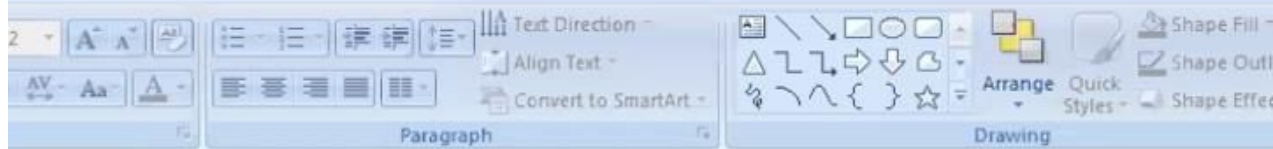


Parenteral Routes

Administration of drugs by routes other than alimentary tract is called parenteral administration. In practice, it refers to administration of drugs by injection.

Advantages of inj:

- i. More rapid & predictable absorption than when drug given orally.
- ii. Parenteral therapy is useful when pt. is unconscious, uncooperative or unable to retain the drug given by mouth.
- iii. Drug is not inactivated or destroyed by mouth



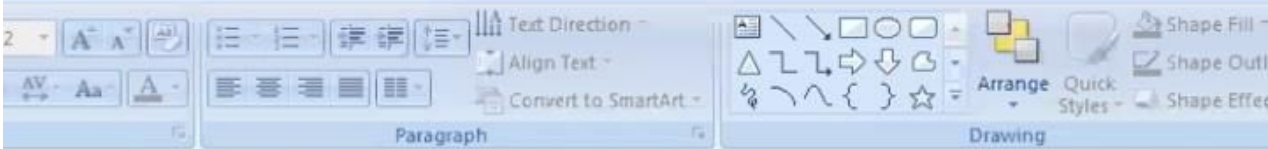
as may happen in GIT after oral administration.

iv. Usually smaller doses are required.

On the other hand parenteral therapy is more painful requiring caution, skill & technique. Strict asepsis must be maintained in order to avoid infections.

Moreover it is difficult for pt. to take injections himself if self medication is necessary.

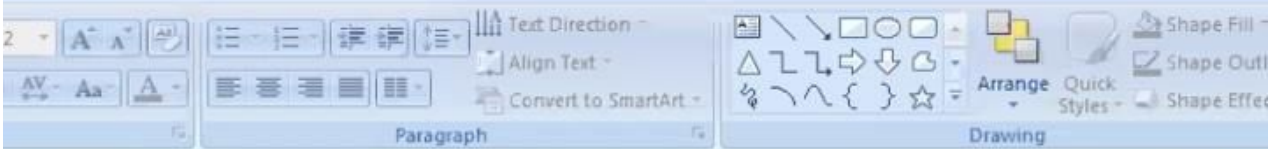
Injections are also more expensive & less safe than oral therapy.



Parenteral injections:

Most common Parenteral injections:

- **Subcutaneous** S/C
- **Intramuscular** I/M
- **Intravascular** I/V Intravenous
/intra-arterial



Less common Injections:

Intra-thecal

Intra-articular

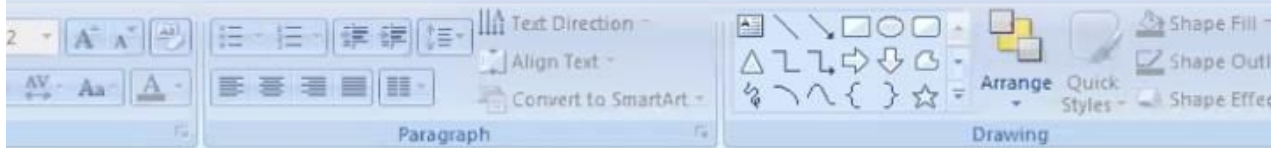
Intra-cardiac

In the bone marrow

Intra-peritoneal

Intra-pleural

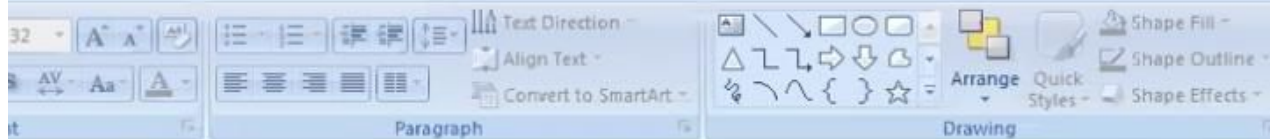
Intra-dermal



Subcutaneous Injections:

Drugs are injected into the subcutaneous tissue

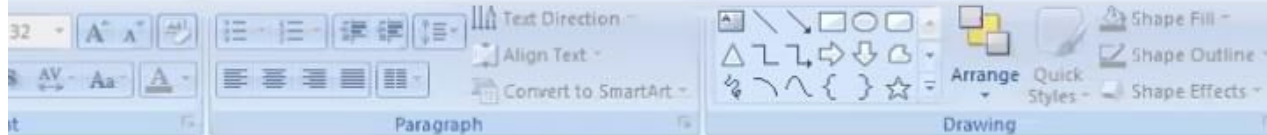




Drug is rapidly absorbed by BV & lymphatics. Possibility of drug being destroyed in stomach & having an irritant effect on GIT as may occur after oral administration is avoided. Drug is thus surely absorbed.

Vol. of fluid to be injected should not be more than 2mls.

SITES: Generally forearm, arm & thigh are selected but when a large amount of fluid is to be injected, loose areolar tissue of subcapsular region or mammary region is selected. **Fluid used should not contain solid particles nor it should be irritating otherwise abscesses will result.** It must be aseptic. **Irritant drugs more readily tolerated when injected**



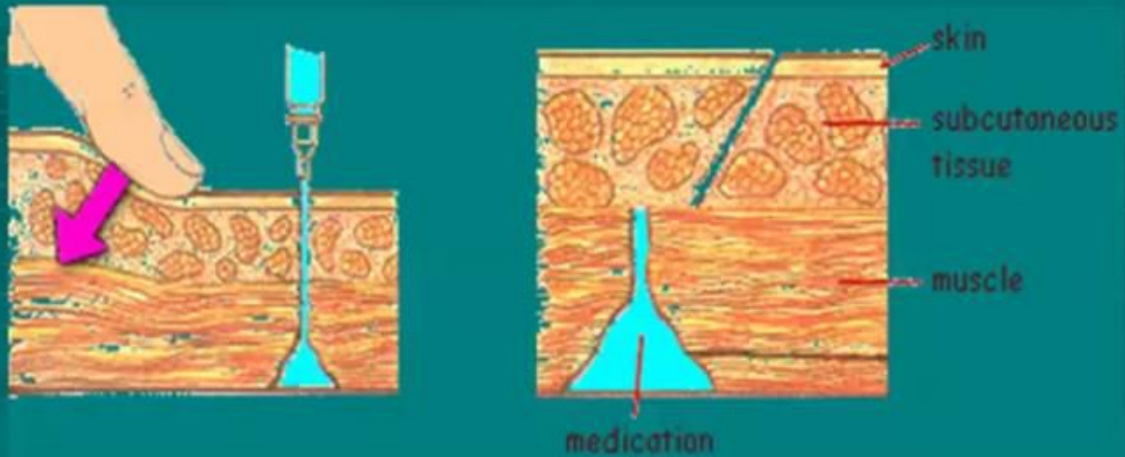
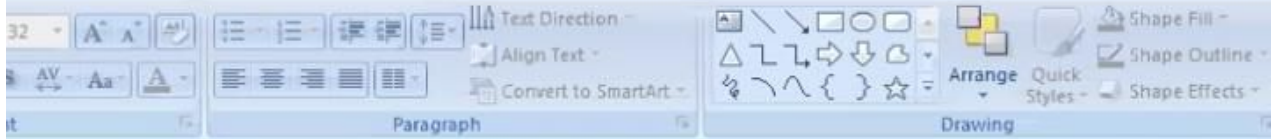
by IM & still better when given slowly IV.

Advantages:

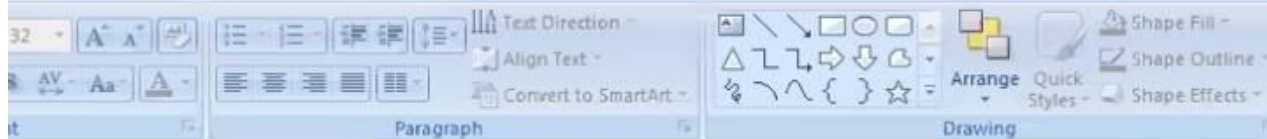
- **Slow and constant absorption**
- **Absorption may be varied intentionally – insoluble insulin is absorbed slowly as compared to soluble preparation.**
- **Vasoconstrictor incorporation also retards absorption**

Disadvantages:

**Very Limited drugs can be given
(non-irritating to tissues)**



Z-track method for IM injections



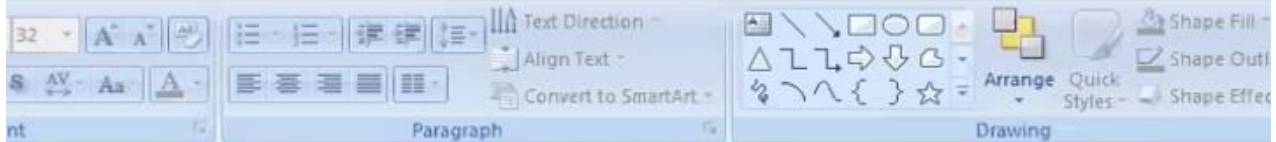
Intramuscular injection: Drug is injected into the layers of skeletal muscles.

Drugs in solution or suspension form is injected deeply into large muscle such as upper & outer quadrant of deltoid, buttock & thigh.

Absorption of drug by IM inj. is more rapid than when given by SC route. Mild irritant can be injected IM without causing intolerable pain.

If IM is not given carefully, a nerve or vein may be injured. Nodules or abscesses may be formed.

To reduce pain during IM inj. pt. should be encouraged to relax the muscle selected for injection site. Skin antiseptic should be allowed to dry on applied surface before inj.



For every inj. new needles should be used.

Needle should be inserted rapidly to minimize puncture pain. After inj. needle should be withdrawn rapidly.

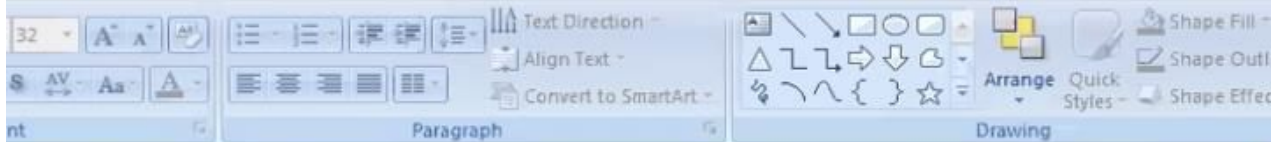
Advantages:

Rapid absorption of drugs (**aqueous solu**)

- Very slow, constant absorption from I/M site – in oily vehicles or suspended in various other repository vehicles
- Substances too irritating to be injected S/C are sometimes given I/M.

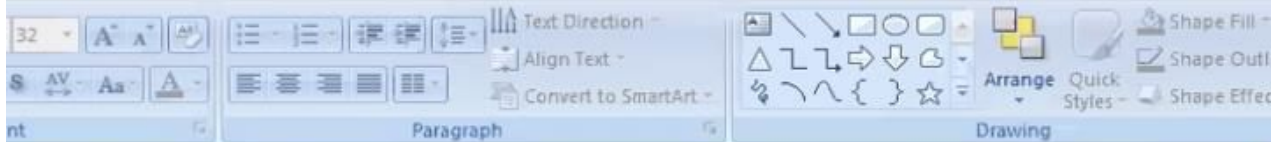
Disadvantages: **Local pain and inflammation**

Pts may exhibit unusual pattern of absorption.



Intravascular Routes: Intra-venous injections

- Drugs are injected directly into the lumen of vein.
- Small or large quantities may be given by this method.
- This route is used in emergencies or for administration of drugs which are too irritating for administration by other routes or for restoration of blood volume.
- There are many veins which can be used for injecting the drug. Generally cubital vein is selected although other convenient veins or even superior longitudinal sinus in children may be selected.



- Median basilic vein should not be used b/o hazard of injecting drug into nearby brachial artery.
- IV inj. should be given carefully & slowly.
- For 10 ml quantity, at least 1 min must be spent to inject IV.
- Drugs used by this route should be in solution form.
- Substances not soluble in water or oily solutions or suspensions cannot be used.
- If large quantity of fluid is to be injected, drug is given in the form of IV infusion slowly eg dextrose solution in water or normal saline.

Advantages: i) Bioavailability is complete and rapid.
ii) Drug delivery can be controlled and achieved with an accuracy and immediately which is not possible by any other procedure.



Google



first pass effect



ALL

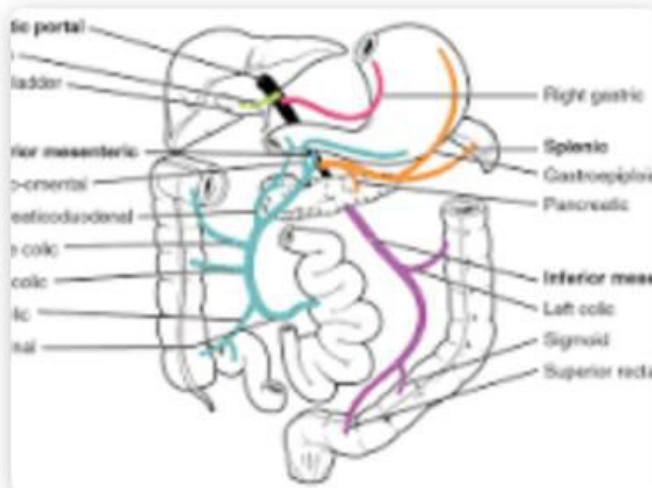
IMAGES

BOOKS

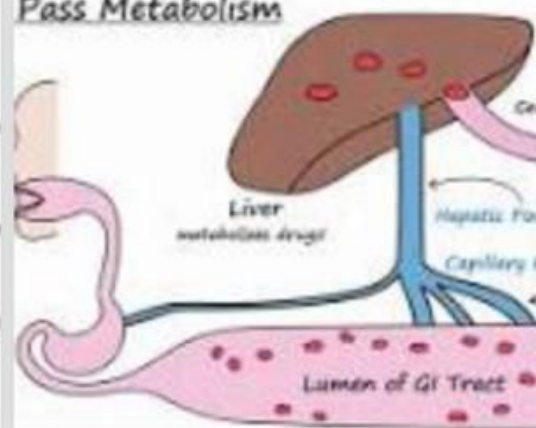
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First pass effect

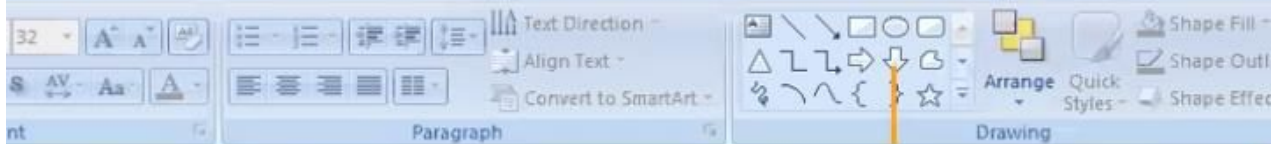


Pass Metabolism



The first pass effect is a phenomenon of drug metabolism whereby the concentration of a drug, specifically when administered orally, is greatly reduced before it reaches the systemic circulation. It is the fraction of drug lost during the process of absorption which is generally related to the liver and gut wall. [Wikipedia](#)

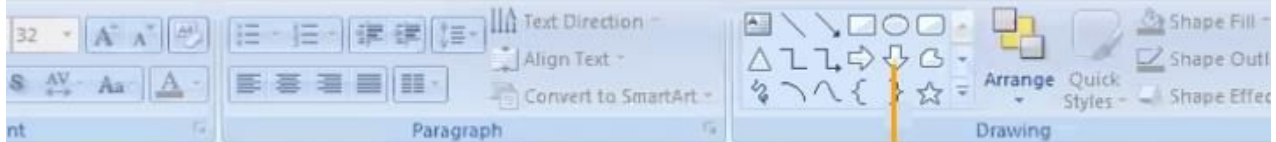
People also ask



- iii) Dose can be adjusted to the response of the patient e.g., Anesthetics
- iv) Irritating solution can be given
- v) Large doses can be given
- vi) Suitable for emergencies and unconscious pts.

Disadvantages: Unfavorable reactions are likely to occur due to increased concentration.

- Patent veins are required.
- Expert person is needed.
- Limited drugs can be given. Also risk of embolism.
- Most frequent hazards with IV infusion are infiltration & phlebitis. To reduce the risk of infiltration, placing IV needles near a movable joint

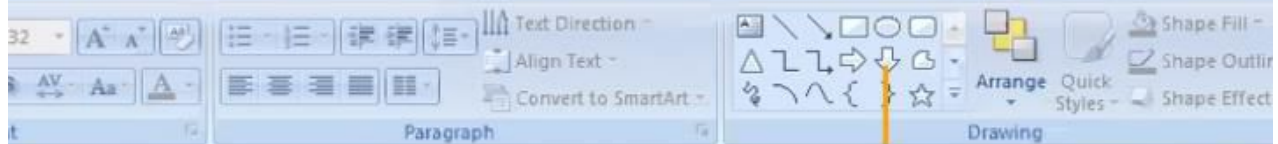


Intra-arterial:

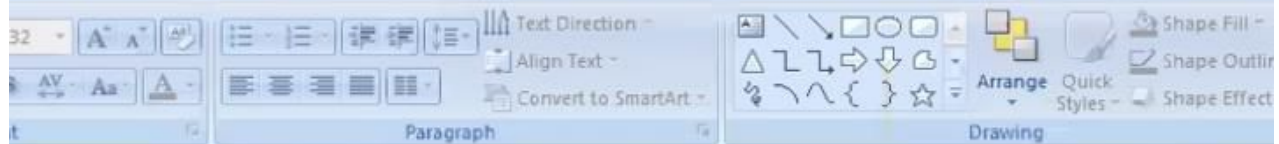
Inj. is made into lumen of an artery. This is done to localize its effects in a particular tissue or organ. In a few seconds, drug goes to its site of action & its potency is not ↓ by tissue enzymes. This method is used in sp. forms of therapy **eg cancer chemotherapy.** **Also for diagnostic purposes.**

Requires great care, reserved for experts.

Intracardiac inj: In sudden stoppage of otherwise healthy heart, drugs are introduced directly into the heart **eg adrenaline.**



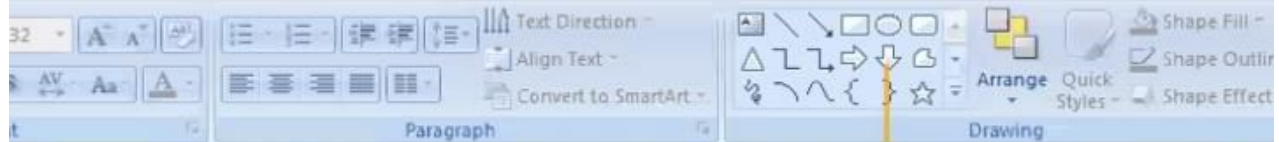
- **Intrathecal inj:** Injection is made into subarachnoid space by lumbar puncture or into cisterna magna. **Intrathecal inj. is often used to produce regional anesthesia.** Less frequently, this route is chosen for administration of drug in proximity to the meninges & brain eg **streptomycin in TB meningitis.**
- **Injection into bone marrow:** A wide bore needle is introduced into marrow cavity. **In adults, sternum is usually chosen but in young children, tibia is preferred.** Bone marrow injections are used mainly when it is impossible to give the drug IV & mainly used for diagnostic



purposes eg haematological disorders.

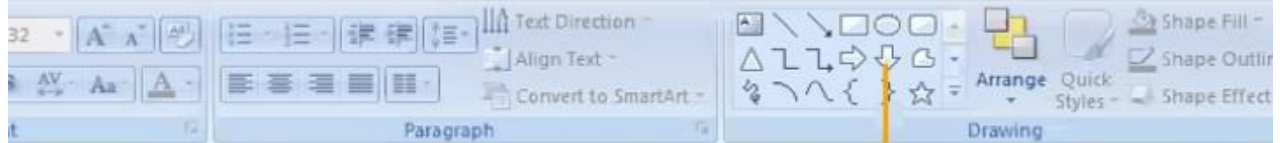
Occasionally blood transfusion may be given by this route.

- Intrapleural inj: When conc. of drug given orally or by SC or IM inj. is not sufficient in pleural cavity, drug is introduced into the cavity directly eg penicillin injected into pleural cavity in empema.
- Intraperitoneal inj: In some conditions involving peritoneal cavity, drug may be given by intraperitoneal route. A large conc. of drug is reached at the affected site. **Also can be used for carrying out peritoneal dialysis for removal**



of urea & creatinine

- Intra-articular inj: Certain drugs can be injected into painful or inflamed joints to ensure high conc. there eg corticosteroids.
- Intradermal inj: This inj. is used for introduction of drugs between layers of skin. This is specially done for **diagnostic purposes** eg **Schick test for diphtheria**, **Dick test for scarlet fever** & for sensitivity tests eg before giving penicillin injection.



Other Routes of Administration:

- **PULMONARY (Inhalation)**
- **TOPICAL APPLICATION**
- **IONTOPHORESIS**