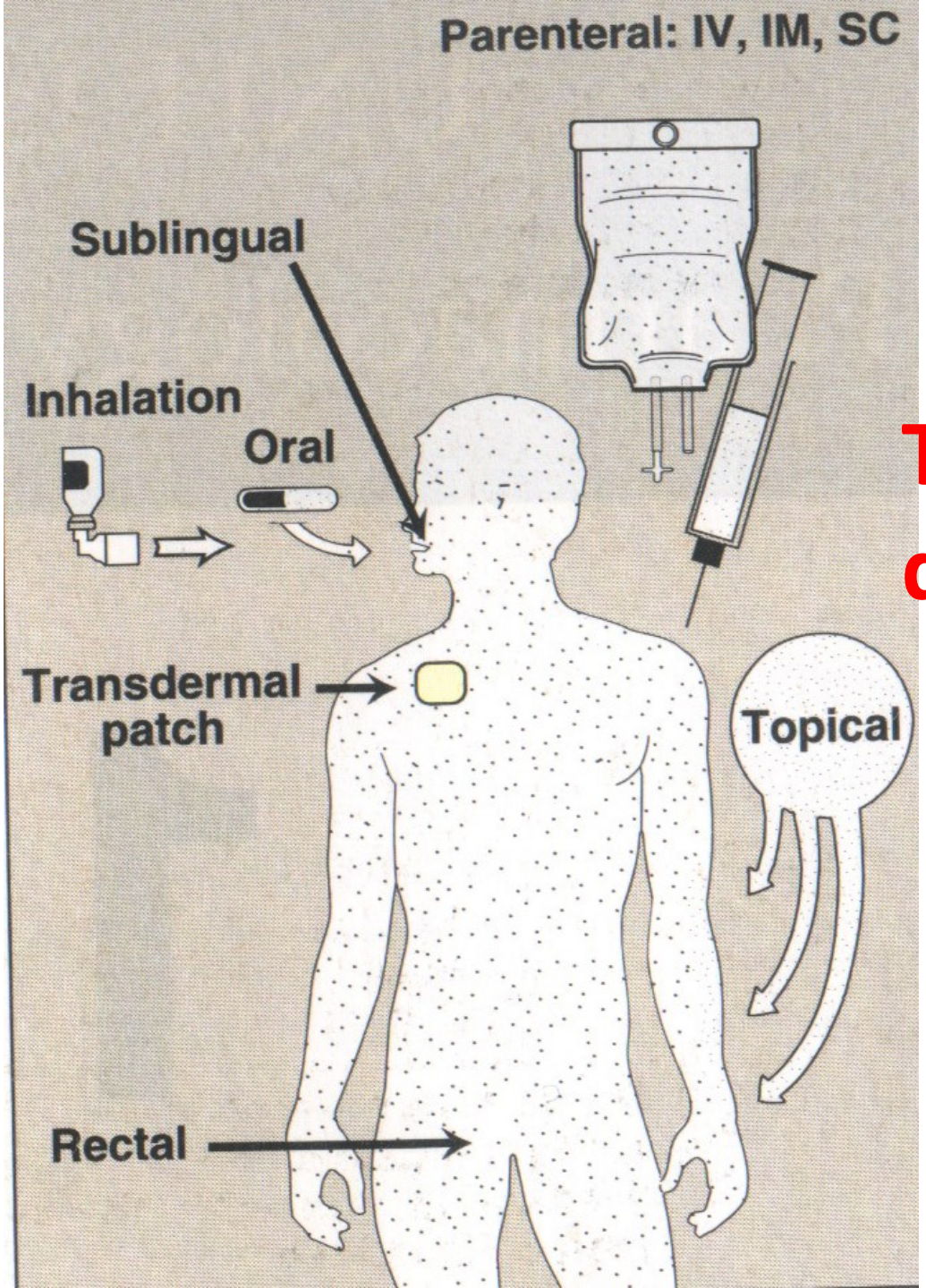
Routes of drug administration



The routes of drug administration

The routes of drug administration

- **Local**
- **systemic**

Local routes – for localized lesions

- **Topical ---** Skin, Mucous membranes
  - mouth, pharynx, eye, ear, urethra, vagina, anal canal, GIT, lungs
- **Deeper tissues --** Intrarticular, intra thecal
- **Arterial**

Systemic route

- **Enteral** (through the alimentary tract)

  Oral , Sublingual, Rectal

- **Parenteral** (*par--- beyond, enteral – intestine)*

  IV, IM, S/C

  OTHERS

  Inhalation, intranasal,

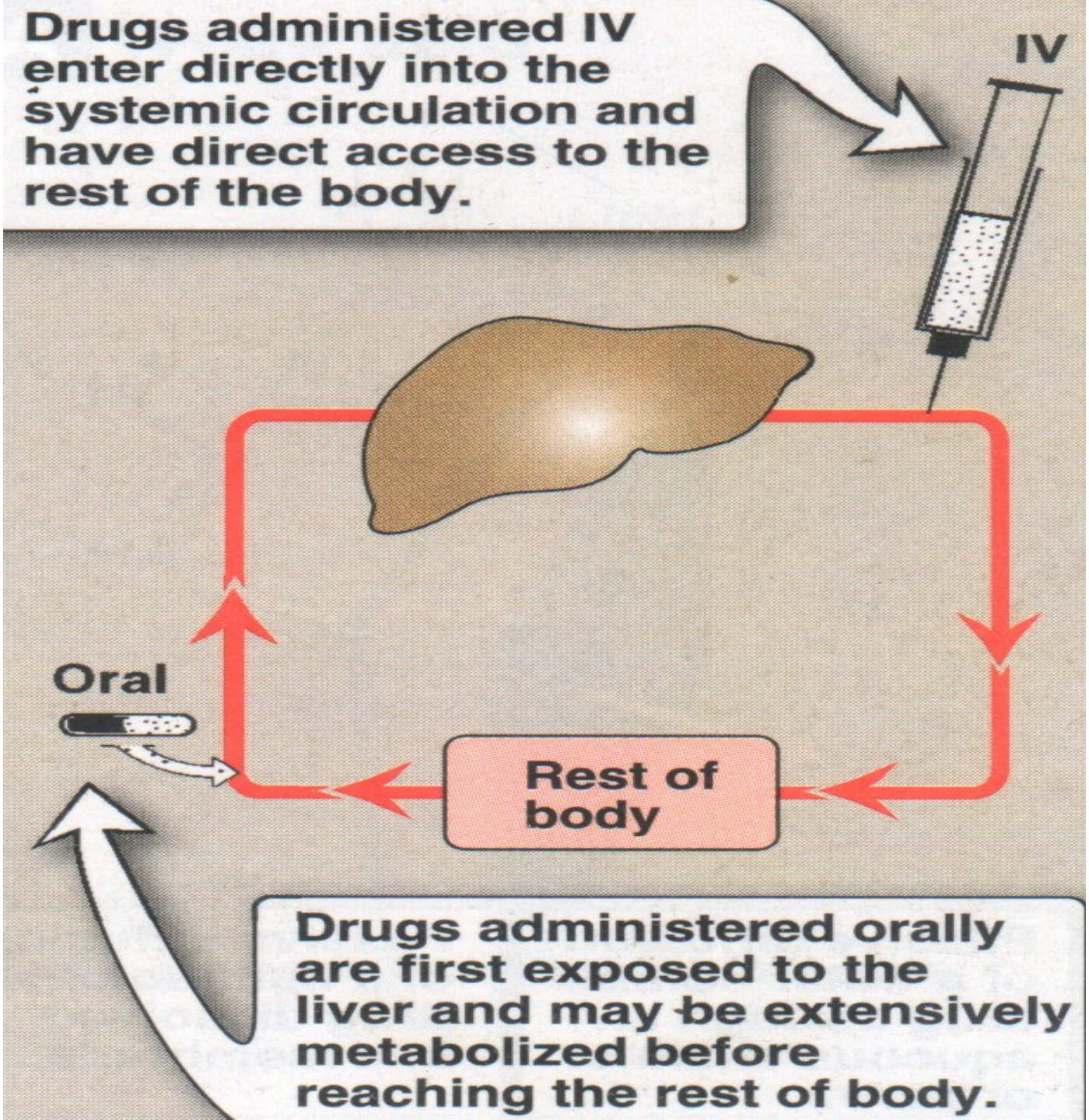
  Transdermal

Factors affecting the route of drug administration

- Properties of drugs
- Therapeutic objectives

Properties of drugs

- Solid/ liquid / gas
- Water or lipid solubility, ionization(pH),irritancy
- Effect of digestive juices & first pass metabolism

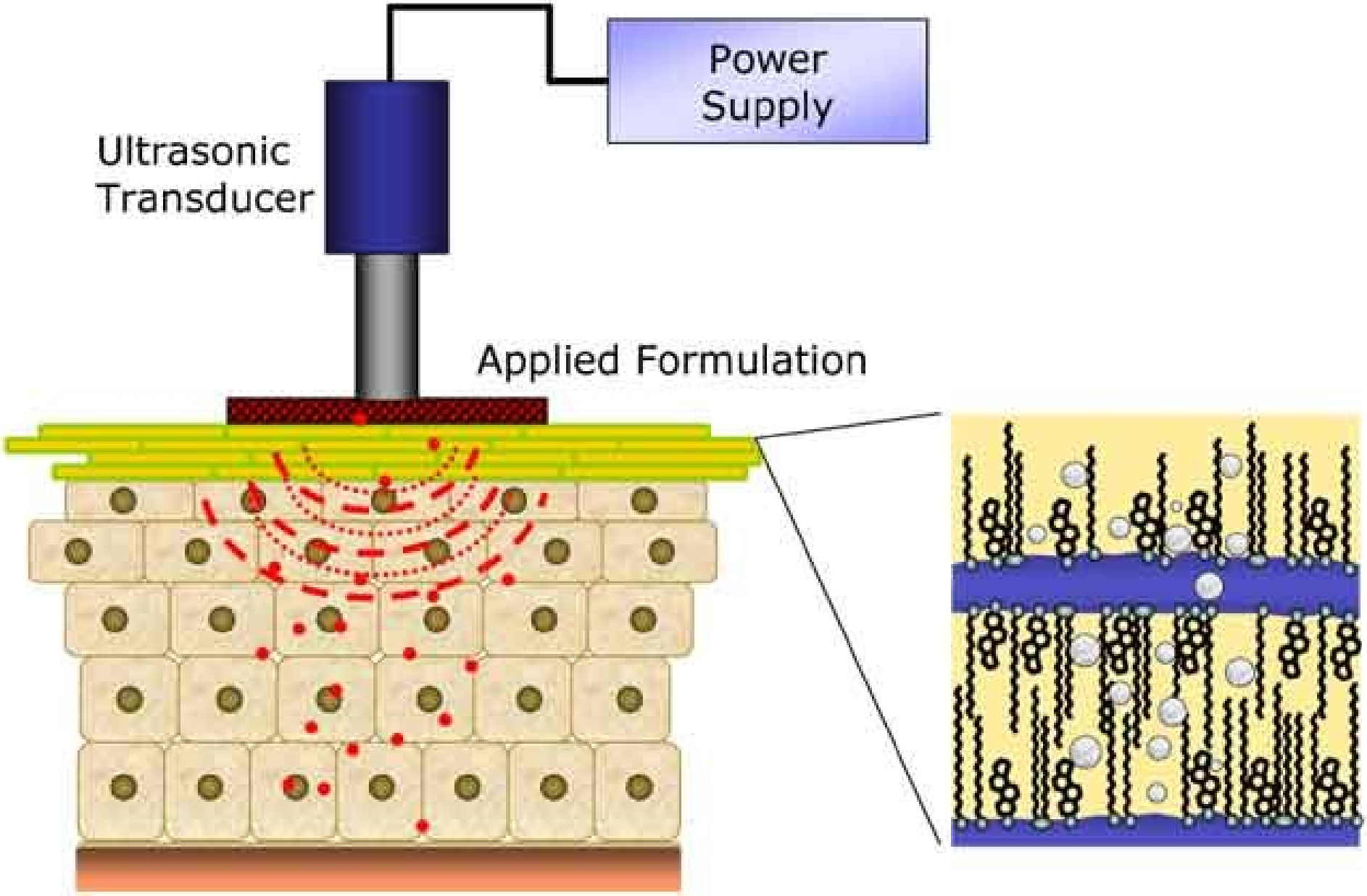

Drugs administered IV enter directly into the systemic circulation and have direct access to the rest of the body.
IV
Oral
Rest of body
Drugs administered orally are first exposed to the liver and may be extensively metabolized before reaching the rest of body.

Therapeutic objectives

- Seriousness and urgency of the disease
- Restriction to a local site /site of desired action
- Need for long term administration

Phonophoresis (or Sonophoresis)

- uses ultrasound energy in order to enhance the skin penetration of active substances…usd as a physiothery


Power Supply
Ultrasonic Transducer
Applied Formulation

- This method uses whole molecules through the stratum corneum
- It gets upto 5 cm
- U must know the polarity of drugs, u r using in this treatment
- Less risk of skin damage

THERMAL EFFECTS (Continous US)

Electricity heats tissue with high collagen content like tendon,ligament and joint capsules

decreases pain,increases tissue extensibility, used for chronic pathology

NON THERMAL EFFECTS (Pulsed US)

…facilitate healing in acute scenarios & alter tissue healing

- Medications used in phonophresis
- Hydrocortisone
- Dexamethasone
- Salicyclates, lidocaine

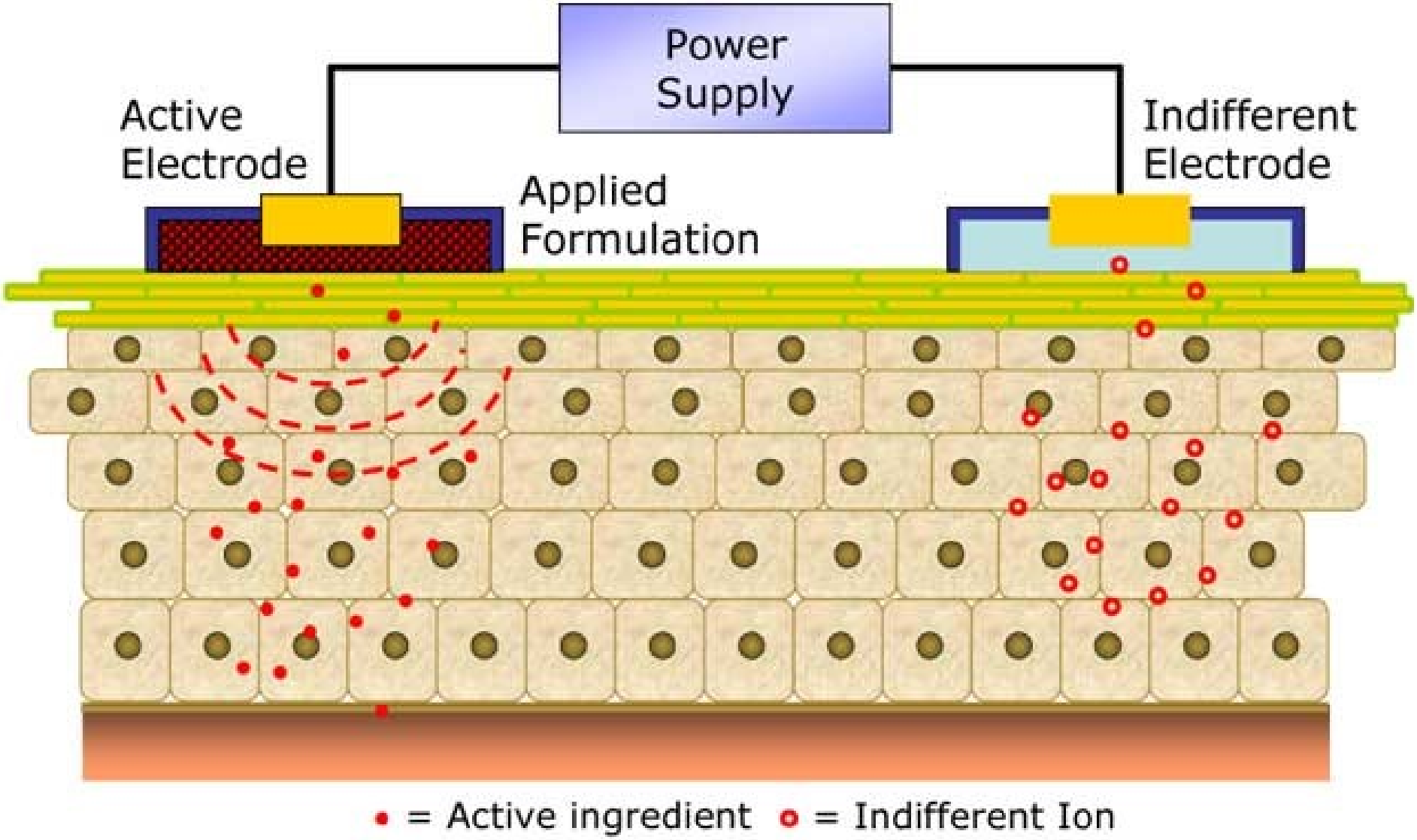
CONTRAINDICATIONS

Cancer, heart problems,cute & post acute injuries, pregnancy,thrombophlebites,impaired sensation, Around eyes

Iontophoresis

- The basic principle of iontophoresis is that a small electric current is applied to the skin
- This provides the driving force to primarily enable penetration of charged molecules into the skin
  - A current passed between the active electrode and the indifferent electrode repelling drug away from the active electrode and into the skin.
  - The active electrode effectively repels the active substance and forces it into the skin

Anode will repel positively charged chemical species, wheras cathode will repel negatively charged species into skin


Power Supply
Active Electrode
Indifferent Electrode
Applied Formulation
• = Active ingredient
o = Indifferent Ion

- In a manner of speaking,injection without a needle,non invasive

CLINICAL CONDITIONS & DRUG USED

Calcific tendinitis,myositis ossificans….Acetic acid

Musculoskeletal spasm..Chloride, $MgSO_4$

Inflammation of soft tissues..Dexamethasone

Rhematoid athritis…ZnO_2

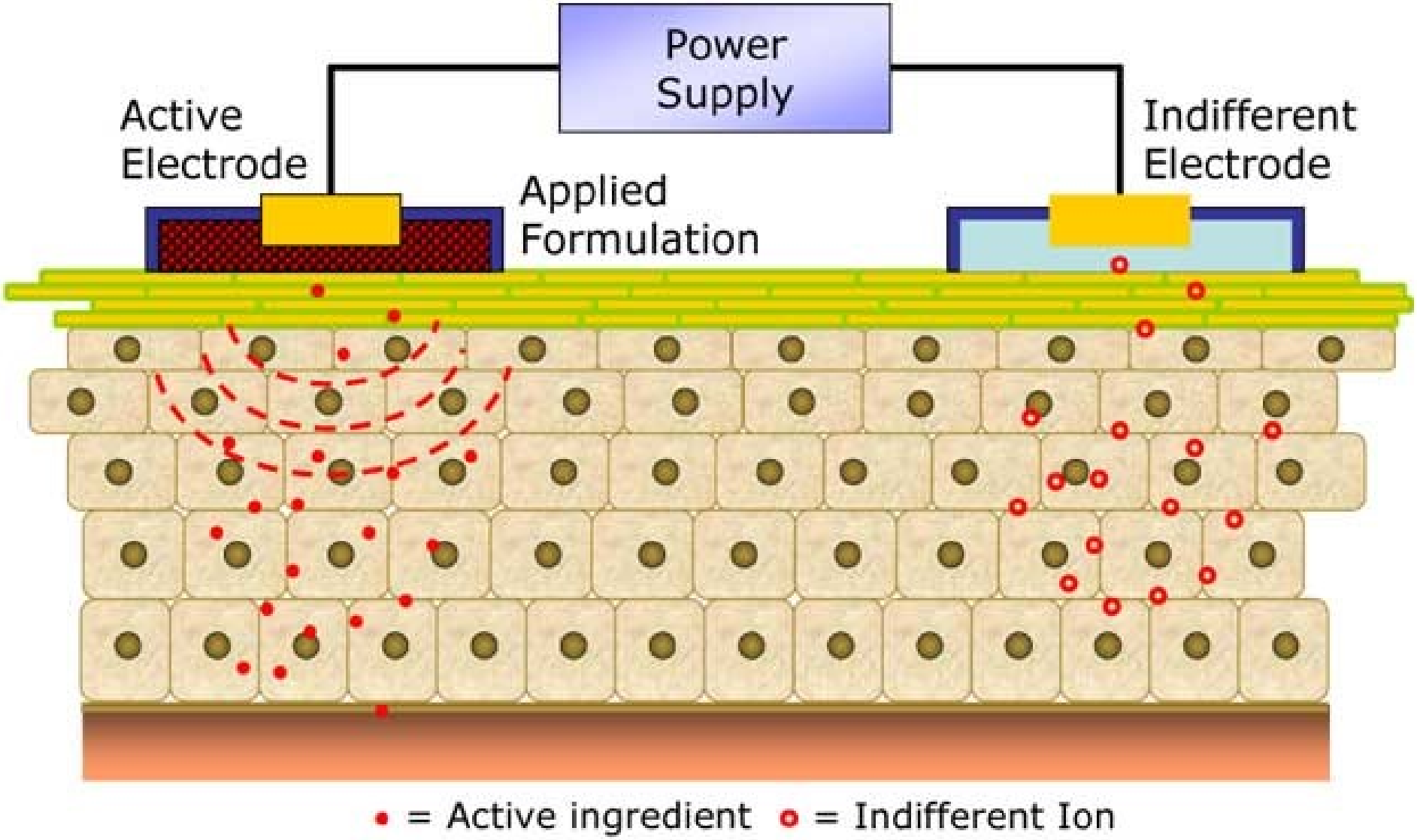
ADVANTAGES

- Increased release & control of therapeutic agents,including drugs with high molecular weight

DISADVANTAGES

- Complexity of drug release system
- Prolonged exposure of skin to an electric current
- more risk of skin damage,as ions r in water solution

- CONTRAINDICATIONS TO IONTOPHRESIS
- Neuralgia, edema,,
- Hyperhidrosis,Planter warts,
- Gouty athritis, Calcific tendonitis,
- Scar tissue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Oral route

- **The drug is taken by mouth & absorbed from GIT**
- Advantages

  most acceptable so most commonly used

Oral route---advantages

- **Most convenient & cheap as Sterile techniques not required**
- **more safe as Onset of action is slow**

Disadvantages of oral route

Most variable route

- **Some drugs can not b used orall because they will b destroyed** by the digestive enzymes or acidity

  e.g …insulin

- some Drugs either **poorly or may not be absorbed**
  - Streptomycin, neomycin

Disadvantages of oral route

Most variable route

- **Disease** affect the absorption
  - Diseases of the gut, Systemic illness
- Ingestion of drugs with the **food** can influence the absorption
  - If given on empty stomach, absorption will be quick

Disadvantages of oral route

Most variable route

- Bioavailability is less
  - First pass metabolism
- Requires compliance
- Irritation of gastric mucosa may cause nausea and vomiting
- Objectionable taste or odor
- Discoloration of teeth may occur e.g., iron mixtures

Oral route is unsuitable in

- **Emergency** situations
- **Unconscious or uncooperative** patients
  - Nasogastric tube may be used

Sublingual or buccal route

- Drug is placed under the tongue or between the cheeks or gingiva

Sublingual or buccal route

- **Advantages**
  - **Rapid absorption & effects** (**GTN in angina**)
    - drug is absorbed into capillary network --- to the systemic circulation directly
    - Effect can be terminated by spitting out the tablet
  - **Avoid first pass metabolism**
    - **Avoid destruction** of drug by intestinal enzymes or by low pH of the stomach

Sublingual or buccal route

- **Disadvantages**
  - Irritation of the mucosa and excessive salivation
  - For only lipid soluble & non-irritating drugs
- **Examples**
  - Nitro glycerine (angised)

Rectal route (per rectum) -- PR

- Drugs are given per rectum for local and for systemic action
- **Suppository** --- Solid
  - glycerine suppositories
- **Enema** --- liquid
  - Diazepam, steroids (for local affect)

Rectal route (per rectum) -- PR

Advantages

- unconscious patient, vomiting or when a patient can not swallow or with young patients
- Drugs avoid first pass metabolism, gastric enzymes and low pH

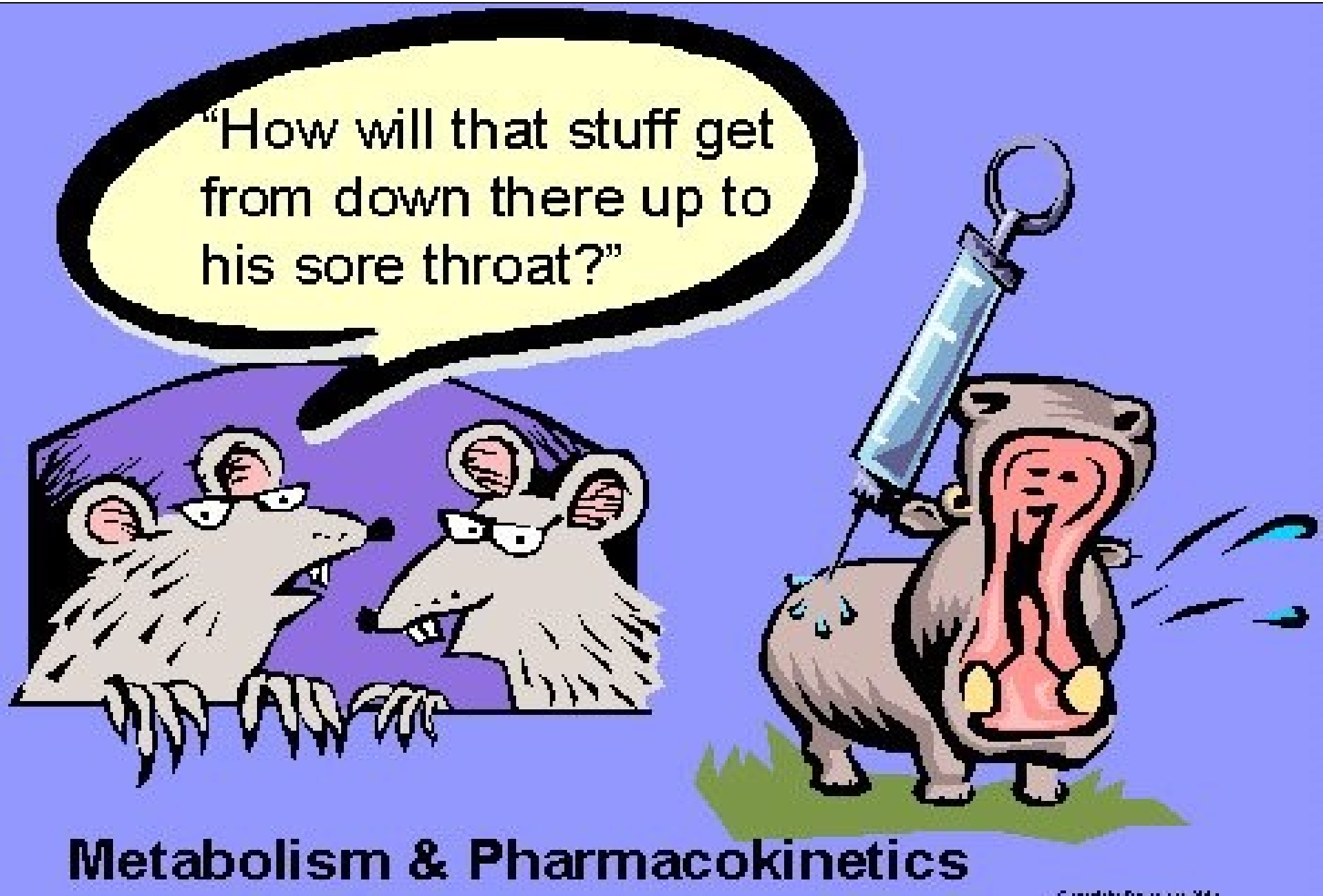
Disadvantages

- Not well accepted
  - Inconvenient & embarrassing
- Absorption is often erratic and incomplete
- Rectal inflammation may occur with repeated use

Intranasal

- Drugs applied as a spray or nebulized solution, different from inhalational route
- **Desmopressin** for diabetes insipidus

Parenteral route



Parenteral route

- **Three common routes**
- **IV, IM, SC**

The advantages

- **More rapid and predictable absorption** than when the drug is given by mouth
  - Rapid onset of action of the drug and get to the site of action more rapidly
- Useful if a patient is **unconscious, uncooperative or unable** to take by mouth

The advantages

- The drug avoids the GI tract and thus first pass metabolism by the liver
- Maximum degree of control over circulating levels of the drug

Disadvantages

- In case of overdose injected **drug cannot be recalled** as it can be done when administered in the GI tract (emesis, activated charcoal)
- Injections are more **expensive** and less safe than oral therapy
- Drugs **cannot be administrated by the patient himself**

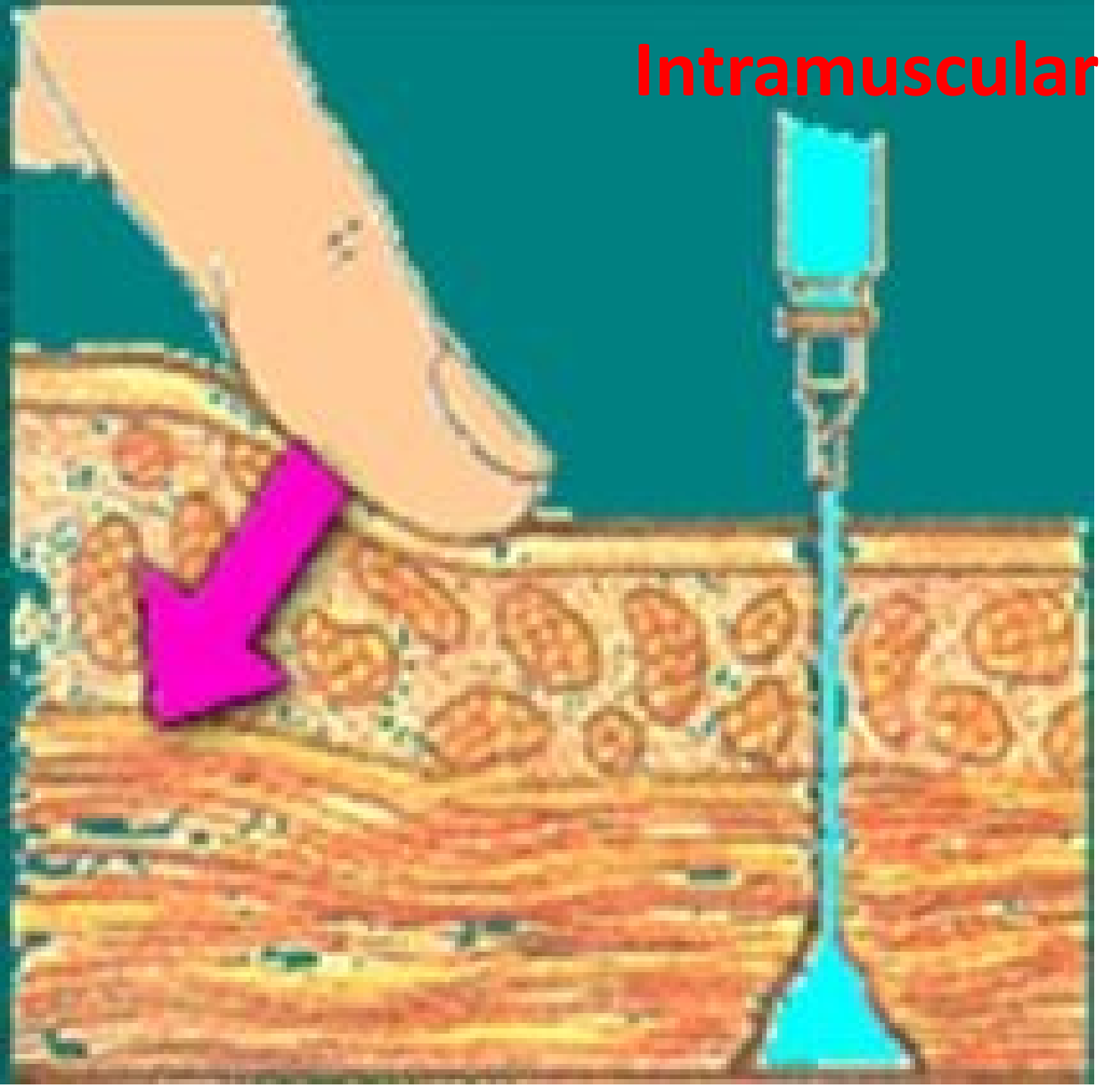
Disadvantages

- Injections are **painful,** requiring **skill and technique.**
- A **sterile formulation and antiseptic techniques are required**
- **Local irritation** may occur at site of injection

subcutaneous

Subcutaneous route (**S/C, SC, Hypodermic)**

- Drug introduced into S/C tissue
- Volume of drug
  - Normally ≤ **2 ml** of fluid



Intramuscular injection

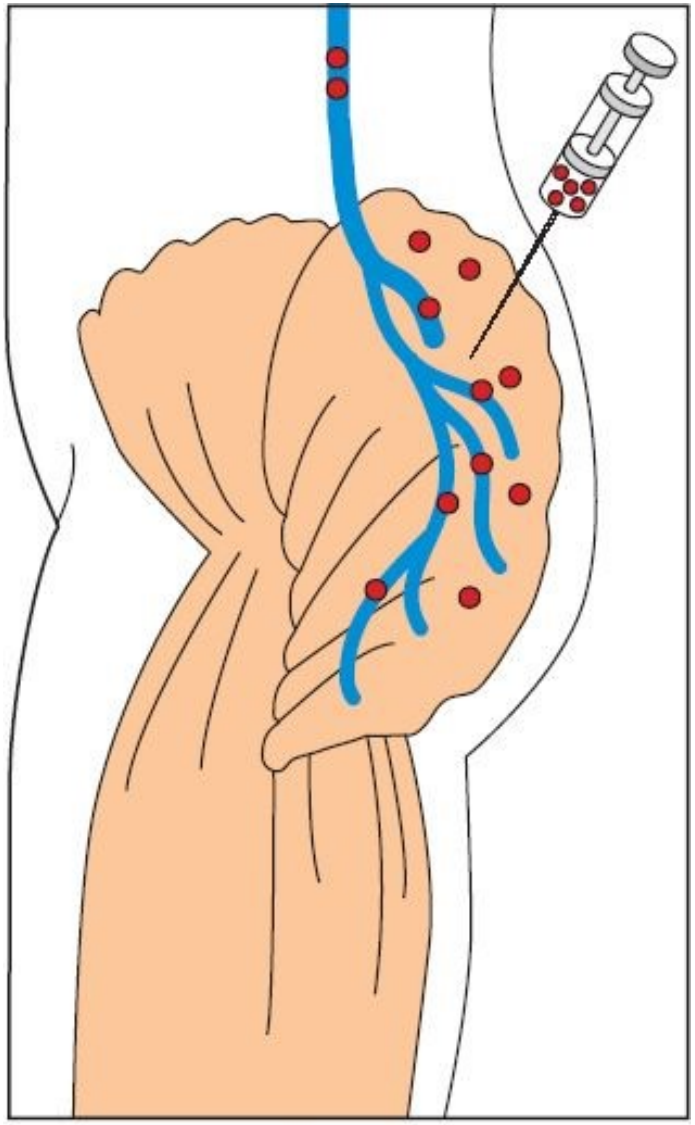
-- IM

-- I/M

Intramuscular injection --- IM --- I/M

- Absorption of drug is more rapid than when given SC

Intramuscular route



Intramuscular

- Up to **2 ml** into deltoid
- **2** to **5 ml** in the – Upper and outer quadrant of buttock

Complications

- Complications are **due to poor technique**
- **Injury to nerve or BV**
- **Injection abscess**
- **I/M hemorrhage (anticoagulant therapy)**

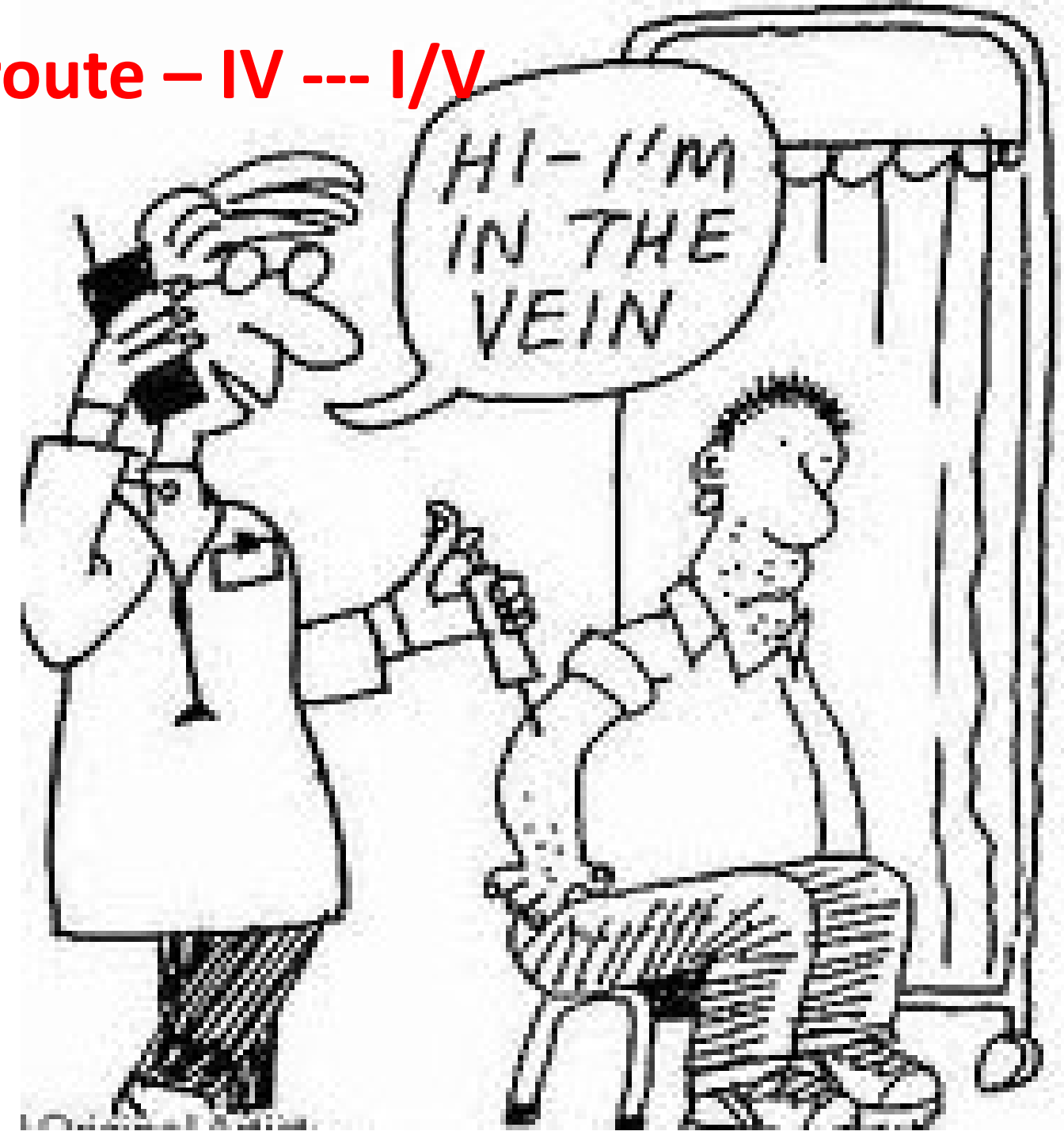
Factors affecting the rate of absorption

- **↑ in blood flow at site of injection ---↑** the absorption.

  - A hot bath

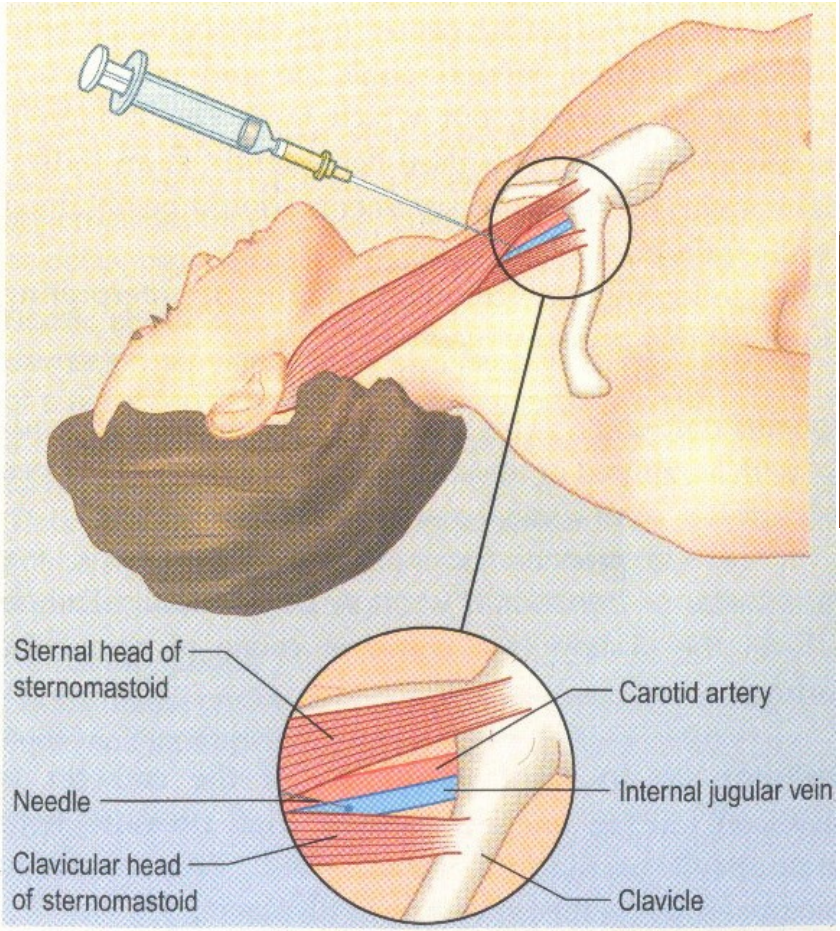
  - Exercise

Intravenous route – IV --- I/V

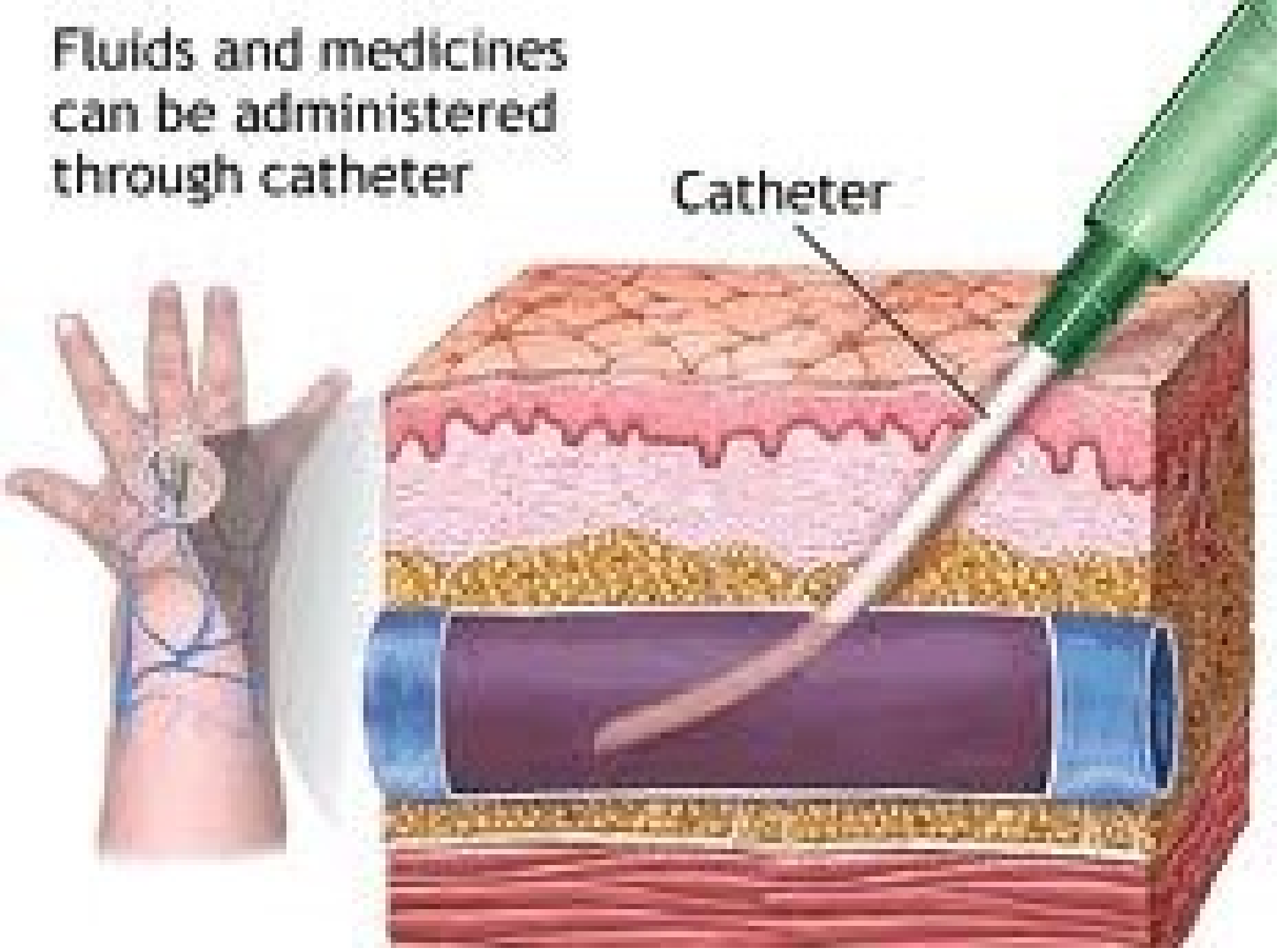


Intravenous route – IV --- I/V

Central vein



Peripheral vein


Fluids and medicines can be administered through catheter
Catheter

Intravenous route – IV --- I/V

- The drug is injected directly into the lumen of a vein as
- **Bolus**
- **infusion**

Advantages of I/V route

- **Bioavailability is rapid and 100 %**
- Small and large **quantities** may be given

Advantages of I/V route

- **Effect can be terminated by stopping the infusion**
  - Eg surgical anesthesia
- Useful for high-molecular-weight protein and peptide drugs
- Irritating solutions can be given by this route

Disadvantages--- I/V

- Not suitable for oily solutions or poorly soluble substances.
- Drugs precipitating blood constituents or hemolyzing RBCs cannot be given.
- Phlebitis --- is common with infusion of high concentration of irritating drugs

Disadvantages --- I/V

- High concentration attained rapidly so greater risk of adverse effects
- Risk of embolism

Less common injections

- Intrathecal
- Intraarticular
- Intrapleural
- Intradermal
- In the bone marrow
- Sub conjuntival
- Intra-vitreal
- Intraperitoneal
- Intracardiac

Intra arterial injection

- **Diagnostic**
  - Angiography,
- **Therapeutic**
  - Chemotherapy of malignant disease drug is injected into lumen of an appropriate artery **to localize the effect of a drug in a particular tissue or organ**, e.g., cancers of liver, head & neck.

Intradermal (intracutaneous) injection

Drug is injected between the layers of the skin raising a bleb

Specific purposes

Intradermal(intracutaneous)injection

- **For sensitivity tests** such as before giving penicillin injection

Intrathecal

- When local and rapid effects of drugs are desired drug is injected directly into the CSF --- into the **subarachnoid space**
  - BBB & blood-CSF barrier
- **For regional anesthesia**
  - Lignocaine
- **Therapeutic purpose**
  - Amphotericin B to treat cryptococcal meningitis

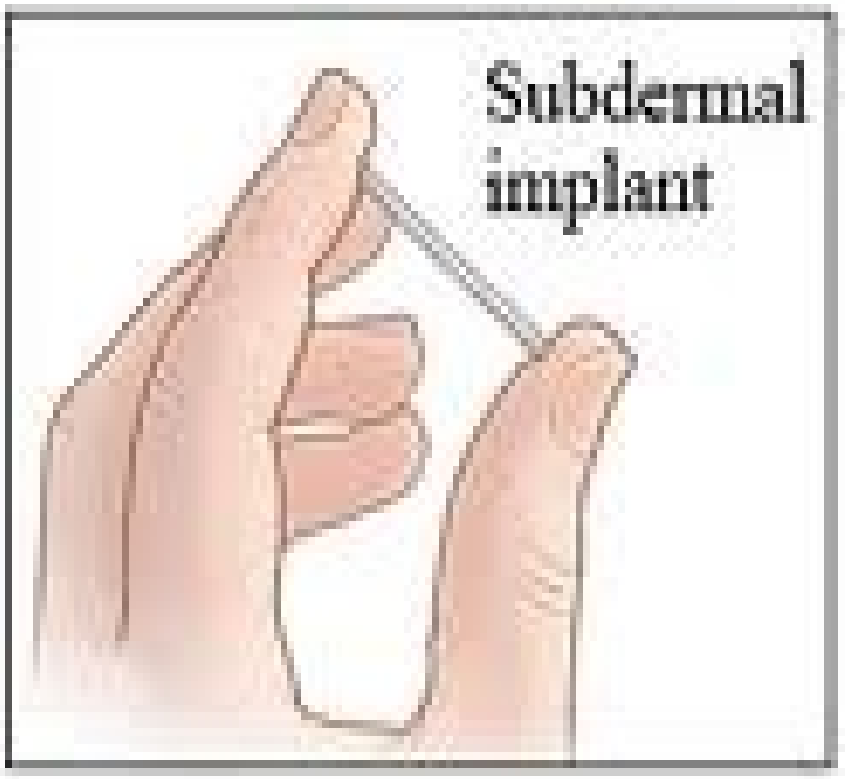
- **Intracardiac**
  - Adrenaline during CPR
- **Intraperitoneal** injections
  - Peritoneal dialysis
- **Intra articular** injection
  - Corticosteroids (hydrocortisone acetate)

Injection into the bone marrow

- Sternum, iliac crest, tibia (in young children)
- **Diagnostic**
  - Aspiration and bone marrow biopsy

Implantation

- For sustained release of drugs over weeks and months
  - –Testosterone
    - pills
  - –Hormones and contraceptives
    - tubes



Implant is placed underneath skin of arm

Inhalation (Gaseous and volatile drugs)

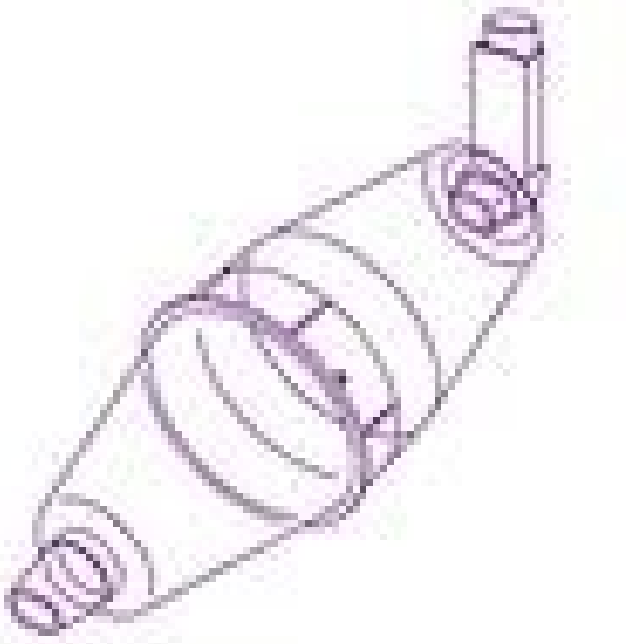
- Gaseous and volatile drugs are inhaled
- Local
  - Effective & convenient for respiratory diseases
- Systemic
  - To produce GA

Inhalation

- **Nebulizers** --- Fine particles of a drug usually suspended or dissolved in **water**
- **Aerosols --** Are suspension of fine solids or liquid particles in **air or gas**
- **Steam**

Metered dose inhalers (MDIs)

MDIs with Spacers



Deposition can be increased
by holding the breath in inspiration

Advantages

- Rapid absorption into the blood & rapid onset of action, as rapidly as I /v injection
- Avoidance of hepatic first-pass metabolism
- Systemic side effects are minimized

Disadvantages

- Irritation of pulmonary mucosa
- Difficulty in regulating the exact amount of drug
- Inhalation of environmental toxins

Topical application

- Application of drugs to external surfaces for localized action
- Skin
  - Ointment, cream, lotion, paste, powder, dressing, spray
- Mucous membranes

Topical application to mucosal surfaces

- For their local effects.
  - Local applications are sometimes absorbed to produce systemic toxicity.
- For systemic effects
  - Antidiuretic hormone is applied to the nasal mucosa for systemic absorption

Transdermal

- To achieve systemic effects by application of drugs to the skin
- Absorption is ↑ed by suspending the drug in an oily vehicle
- Transdermal patches (controlled released Topical patches) -- Used for sustained delivery of drugs

- Nitroglycerine, Nicotine,

Disadvantages -- transdermal

- Allergy to patch– irritation
- Drug must be highly lipophilic
- May cause delayed delivery of drug to pharmacological site of action
- Limited to drugs that can be taken in small daily doses