rmation on pharmacology books, visit our website www.jaypeebrothers.com, for detailed information on pharmacology books, visit our website www.jaypeebrothers.com



diginerve
A Jaypee Initiative
• Video Lectures • Dr. Wise AI Chatbot
• Question Bank • Notes
Download App

3rd Edition

Revised Reprint

Exam Preparatory Manual for Undergraduates

PHARMACOLOGY

A Clinically Integrated Approach with Case Scenarios and Clinical Applications

HIGHLIGHTS

- New ***Mind Map*** concept to assist visual memory
- ***Compare–Contrast*** series to improve depth
- More ***Mnemonics*** to help memorize
- Concise yet comprehensive text for exam preparation

As per the Revised Competency Based Medical Education Curriculum (NMC)

Padmaja Udaykumar

JAYPEE

CONTENTS

Section 1: General Pharmacology 1

Section 2: Autonomic Nervous System 62

Section 3: Autacoids and Related Drugs 111

Section 4: Anesthetics 140

Section 5: Central Nervous System 156

Section 6: Drugs Acting on the Kidney 217

Section 7: Blood 229

Section 8: Cardiovascular System 245

Section 9: Respiratory System 294

Section 10: Gastrointestinal Tract 304

Section 11: Drugs Used in Hematological Disorders 330

Section 12: Drugs Used in Endocrine Disorders 336

Section 13: Chemotherapy 407

Section 14: Immunopharmacology 539

Section 15: Toxicology 550

Index *579*

SECTION 4

Anesthetics

LOCAL ANESTHETICS

PH 1.17: Describe the mechanisms of action, types, doses, side effects, indications, and contraindications of local anesthetics.

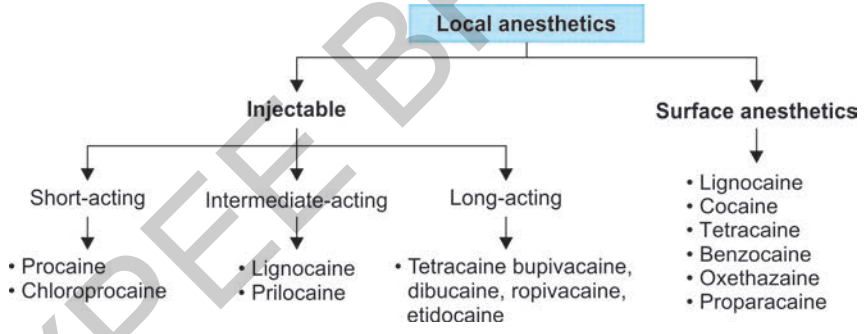
Local anesthetics (LA) are drugs that reversibly block nerve conduction when applied locally to the nerve tissue in appropriate concentrations.



Local anesthesia is reversible loss of sensation without loss of consciousness.

Classification

Based on the Route of Administration



Based on Structure

Local anesthetics are bases and consist of an amino group on one side and an aromatic group on the other, joined by an intermediate chain through an ester or amide linkage. Based on the structure, LA can be esters or amides.

COMPARE AND CONTRAST ESTER AND AMIDE LOCAL ANESTHETICS

Features	*Esters*	*Amides*
Chemistry	Have ester link	Have amide links
Metabolism	By plasma esterases	Metabolized in liver (not by esterases)
Duration of action	Shorter acting	Longer acting
Allergic reactions	More common	Less common
Anesthesia quality	Lighter	More intense

Contd...

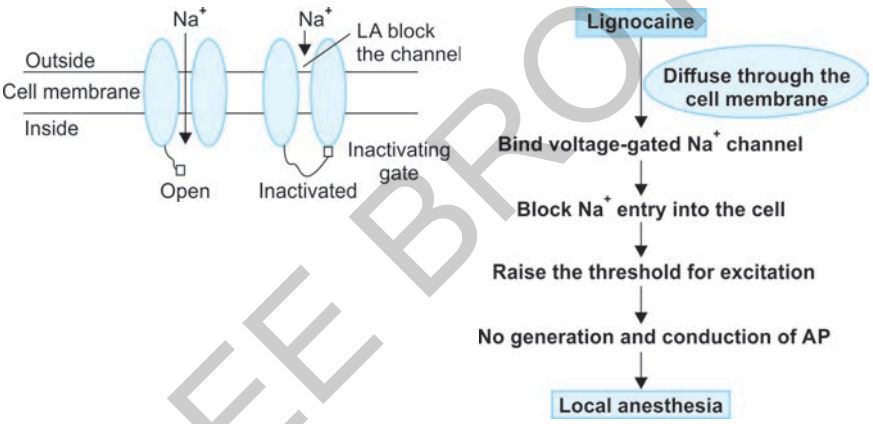
JAYPEE BROTHERS

Contd...

Features	Esters	Amides
Use	Used topically	For nerve blocks and other deeper anesthesia
Examples	Procaine, tetracaine, cocaine, benzocaine, chloroprocaine.	Lignocaine, mepivacaine, bupivacaine, ropivacaine, etidocaine, prilocaine, articaine

Note:
- All esters have single 'i' in their names
- All amides have double 'i' in their names

Mechanism of action: Local anesthetics penetrate through the cell membrane and bind to the voltage-sensitive sodium channels from the inner side of the cell membrane. They block the voltage-gated sodium channels. Local anesthetics prevent the generation and conduction of nerve impulses. Local anesthetics are bases and consist of an amino group on one side and an aromatic group on the other, joined by an intermediate chain through an **ester** or **amide** linkage. Threshold for electrical excitability increases.



Pharmacological actions: Local anesthetics interfere with the functions of all organs in which conduction or transmission of impulses occur. Thus nervous system, autonomic ganglia, neuromuscular junction (NMJ) and all muscles are affected.

1. **Peripheral nerves:**
   - Small nerve fibers are blocked first and then the large fibers.
   - Autonomic fibers are blocked first followed by sensory fibers conducting pain, temperature, sense, then touch, pressure, and vibration sensations in the same order and then motor fibers **(differential blockade)**.
   - Small nonmyelinated fibers are blocked faster than the myelinated fibers.
   - Among the fibers of same diameter myelinated fibers are blocked faster than the nonmyelinated.
2. **Systemic actions:**
   i. ***Central nervous system (CNS):*** Local anesthetics depress the cortical inhibitory pathway and this loss of inhibition results in restlessness, tremors, and may proceed to the convulsions. The central stimulation is followed by generalized CNS depression and death may result from the respiratory failure.

JAYPEE BROTHERS

ii. ***Cardiovascular system (CVS):***
- **Heart**—local anesthetics are myocardial depressants. They block the sodium channels in the myocardium resulting in decreased force of contraction and conduction rate—quinidine-like effects. Since procaine is short-acting, procainamide is used as an antiarrhythmic.
- **Blood vessels**—local anesthetics cause hypotension due to sympathetic blockade and arteriolar dilatation.

iii. ***Smooth muscle:*** Local anesthetics depress contractions in the intact bowel and relax vascular and bronchial smooth muscles.

Combination of Adrenaline with a Local Anesthetic

Case Scenario

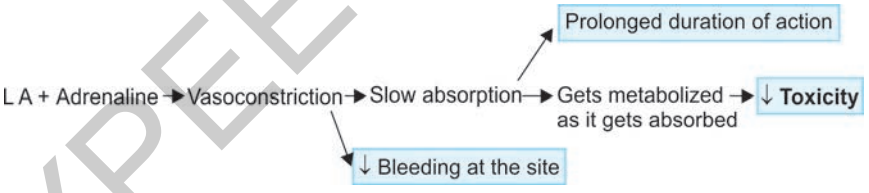
Suresh, a 40-year-old construction worker comes to the emergency care with a cut in the upper arm. It requires suturing under local anesthesia. A dose of adrenaline was also used with the LA.

❑ Explain why adrenaline is used with lignocaine/LA?

Addition of a vasoconstrictor like adrenaline (1:50,000 to 1:2,00,000) or phenylephrine (1:20,000) with lignocaine for infiltration is done for:

Advantages

1. Adrenaline causes vasoconstriction → prolongs the duration of action of LA by slowing the rate of absorption from the site.
2. Reduces systemic toxicity of LA because absorption rate is reduced and as it gets absorbed, it gets metabolized.
3. Reduces bleeding at the site.



Disadvantages

1. Adrenaline may get absorbed systemically and cause adverse effects.
2. Wound healing may be delayed due to reduced blood flow to the site.

Adrenaline should not be used (alternative felypressin)

1. Around end arteries to avoid necrosis as in fingers and toes.
2. Intracutaneously to avoid sloughing.
3. In hypertension, arrhythmias and thyrotoxicosis.
4. IV regional anesthesia.

Felypressin, a synthetic analog of vasopressin can be used with LA as a vasoconstrictor in place of adrenaline. It is safe in patients with cardiovascular diseases. It is a uterine stimulant—avoid in pregnant women.

In presence of inflammation or infection, LA are less effective which could be because:

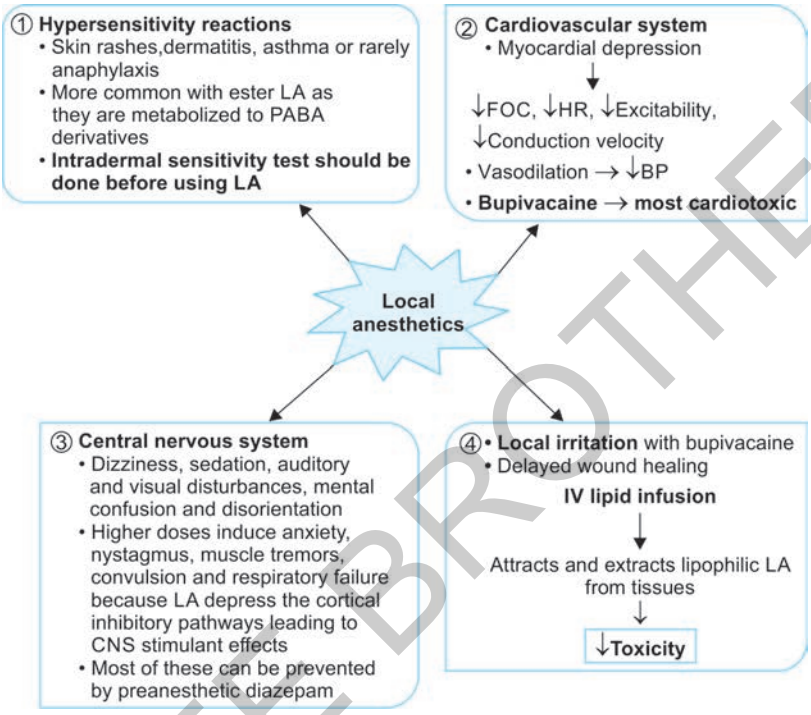
1. Inflamed tissue has acidic pH but LA are weak bases and they ionize in such acidic medium. Therefore a very low fraction of nonionized LA is

JAYPEE BROTHERS

available for diffusion into the cell. Because of this LA penetration may be low.

2. Presence of products of inflammation at the site may counter the action of LA.
3. In presence of inflammation, the local blood flow is increased and the LA is washed off more rapidly.

Adverse effects



Techniques of Local Anesthesia

Table 4.1: Types/techniques of local anesthesia (LA).

Technique, drugs used	*Salient features*	*Indications and remarks*
1. **Surface anesthesia** **Drugs:** Tetracaine: 2% Lignocaine: 2–10% Proparacaine: 0.5% Benzocaine Dibucaine	**Direct application to:** Mucous membrane of eye, nose, mouth, tracheobronchial tree, esophagus, genitourinary tract; orally to anesthetize gastric mucosa **Advantage:** Application is easy **Disadvantage:** May be absorbed → toxicity	**On the eye for:** Tonometry, Foreign body removal from cornea and conjunctiva, Preoperative preparation. **Others:** Nasal lesions, stomatitis, sore throat, tonsillectomy, endoscopies, intubation, gastric ulcer, burns, proctoscopy, fissure, and piles
2. **Infiltration anesthesia** **Drugs:** Lignocaine Procaine Bupivacaine	Inj of LA directly into tissue: • Superficial—only into skin • Into deeper structures like intra-abdominal organs • Duration can be doubled by **adrenaline** (1:2,00,000)	Adrenaline should not be used: • Around end arteries to avoid necrosis • Intracutaneously to avoid sloughing

Contd...

JAYPEE BROTHERS

Contd...

Technique, drugs used	*Salient features*	*Indications and remarks*
	Advantage: No disruption of normal bodily functions **Disadvantage:** Large amounts needed in major surgeries may result in toxicity	**Uses:** For minor procedures such as incisions, drainage of an abscess, and excision
3. **Field block** **Drugs:** Lignocaine Procaine Bupivacaine	SC inj of LA proximal to the site to be anesthetized **Sites**—forearm, scalp, anterior abdominal wall, and lower extremity **Advantage:** With a small dose of LA, large area can be anesthetized	Knowledge of neuroanatomy of the site is needed **Uses:** Local procedures on scalp, anterior abdominal wall, and lower extremity
4. **Nerve block** **Drugs:** Most local anesthetics	Injection of LA around individual peripheral nerves/plexuses **Advantages:** • Large areas of anesthesia with a small amount of drug • Anesthesia starts in 3 minutes with lignocaine, a few centimeters distal to the injection and lasts longer than by a field block or infiltration	**Brachial plexus block** for—procedures on the arm; **Intercostal nerve blocks**—anterior abdominal wall; **Cervical plexus block**—neck; **Sciatic femoral nerve blocks**—distal to knee; Blocks of nerves at wrist and ankle; **Radial and ulnar nerve blocks** (elbow); Sensory cranial nerves, facial, and lingual nerve; Inferior alveolar nerve block for the extraction of lower jaw teeth **Uses:** For teeth extraction, operations on the eye, limbs, and in neuralgias
5. **Spinal anesthesia**	**(*see* text below)**	
6. **Epidural anesthesia** **Drugs:** Morphine Fentanyl Lignocaine Bupivacaine Ropivacaine	• Injected into the spinal extradural space • Technically more difficult • Larger volumes of anesthetic are needed • Repeated use → tachyphylaxis	**Uses:** • Postoperative pain • Labor pain (obstetric analgesia) • Terminal cancer pain
	Advantages: • Small doses provide good analgesia • Sensory blockade 4–5 segments higher than motor blockade → useful for obstetric analgesia—mother has no pain but can cooperate in labor and is conscious • Not injected into SA space → no chances of infection	

Contd...

JAYPEE BROTHERS

Contd...

Technique, drugs used	*Salient features*	*Indications and remarks*
7. Intravenous regional anesthesia (Bier's block)	Rubber bandages used to force the blood out of the limb (veins) and a tourniquet is applied to prevent the re-entry of the blood. Local anesthesia then injected into a distal vein—diffuses into extravascular tissues Onset of anesthesia—in 2 mins	**Uses:** • Rapid anesthetization of an extremity (upper or lower) procedures <1 hour, ~25% of drug enters into the systemic circulation • More commonly used on the upper limbs

Eutectic Mixture of Local Anesthetics (EMLA) Cream

Lignocaine does not anesthetize the skin—hence EMLA is used.

- Eutectic mixture containing 2.5% each of lignocaine and prilocaine (Ratio 1:1) at room temperature, has a lower melting point than either of the drugs. This is emulsified and applied as a cream to anesthetize the intact skin (should not be used on abraded skin) used on abraded skin).
- The cream should be applied on the skin under an occlusive dressing.
- Can produce anesthesia up to a depth of 5 mm.
- It can be used for procedures like venipuncture and skin graft harvesting.

Spinal Anesthesia

- Local anesthetic solution is injected into the subarachnoid space between L2–3 and L3–4 below the lower end of the spinal cord and it acts on the nerve roots in cauda equina.
- Lower abdomen and lower limbs are anesthetized and paralyzed.
- The level of anesthesia can be altered by the volume of injection, specific gravity of the solution and posture of the patient.
- The level of sympathetic block produced is two segments higher and motor paralysis is two segments lower than the sensory or cutaneous anesthesia.
- Duration depends on the concentration, dose, and the drug itself.
- Lignocaine, tetracaine, bupivacaine, and ropivacaine are used.

Advantages: It is safe, provides good analgesia and muscle relaxation, and there is no loss of consciousness. In cardiac, pulmonary and renal diseases, spinal anesthesia (SA) may be preferred over general anesthesia.

Uses: Surgical procedures on the lower limb, pelvis, lower abdomen, obstetric procedures, and cesarean section are done on spinal anesthesia.

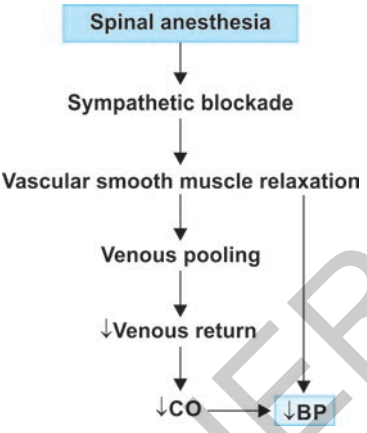
Complications of Spinal Anesthesia

1. **Hypotension and bradycardia:** Sympathetic blockade results in decreased venous return and decreased cardiac output leading to hypotension and bradycardia—*see* Flowchart.
2. **Respiratory paralysis:** Hypotension and ischemia of the respiratory center results in respiratory failure. Due to paralysis of the abdominal muscles,

JAYPEE BROTHERS

cough reflex is less effective resulting in stasis of respiratory secretions, leading to respiratory infections.

3. **Headache** due to leakage of CSF is the most common complication. Pain in the occipital region usually starts after 12–24 hours, gets worse when the patient is erect or sitting—to be avoided for 24 hours. Adequate fluids, abdominal compressor and analgesics may provide relief.
4. **Cauda equina syndrome**—loss of control over bladder and bowel sphincters because of damage to the nerve roots.
5. **Sepsis**—resulting in meningitis.
6. **Nausea and vomiting**—premedication with antiemetics is needed.



GENERAL ANESTHETICS

PH 1.18: Describe the mechanisms of action, types, doses, side effects, indications, and contraindications of general anesthetics, and pre-anesthetic medications.

Case Scenario

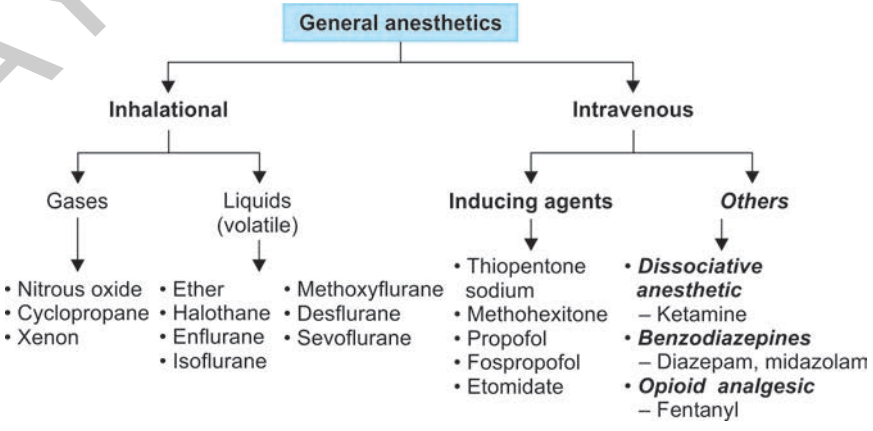
A 40-year-old man is undergoing appendicectomy under general anesthesia. Which are the general anesthetics that can be used for him?

- ❑ Classify general anesthetics.
- ❑ Explain the pharmacokinetic factors which influence the administration of inhalational anesthetics.

Definition

General anesthetics are agents that bring about reversible loss of sensation and consciousness.

Classification



JAYPEE BROTHERS

Inhalational Anesthetics

Pharmacokinetics of Inhalational Anesthetics

Inhalational anesthetics are administered at a specific concentration. Since the brain is a highly perfused organ, a steady state can be achieved quickly.

Factors which influence the partial pressure of the anesthetic attained in the brain are:

1. **Partial pressure of the anesthetic in the inspired gas:** Higher the partial pressure (PP) of the anesthetic in the inspired air, greater is its quantity moving into the blood.
2. **Pulmonary ventilation:** Delivery of the anesthetic into the alveoli is directly proportional to the pulmonary ventilation.
3. **Alveolar exchange:** When ventilation perfusion is appropriate, volatile anesthetics freely diffuse across the alveoli.
4. **Solubility of the anesthetic in the blood:** Lower the solubility of the anesthetic in the blood, faster is the rise of its PP in the blood and faster is the induction.
5. **Solubility of the anesthetic in the tissue:** Anesthetics which are more soluble in tissues like the adipose tissue require a longer time to attain equilibrium.
6. **Cerebral blood flow:** Because the blood flow to the brain is high, GAs reach it rapidly and if other factors are favorable, anesthesia can be rapidly attained.

INHALATIONAL ANESTHETICS

Nitrous Oxide

Q. Write briefly on the role of nitrous oxide in general anesthesia.

Nitrous oxide is a gas with a slightly sweetish odor. It produces light anesthesia without significant depression of respiration or vasomotor center.

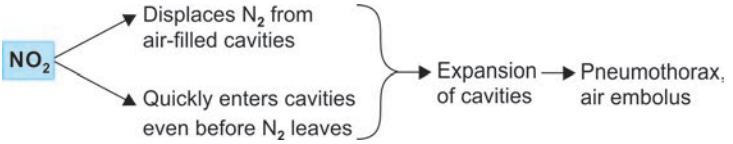
Advantages

1. Strong analgesic.
2. Induction is rapid and smooth.
3. Nonirritating and noninflammable.
4. Recovery is rapid.
5. Postoperative nausea is not significant.
6. Has little effect on respiration and cardiovascular functions → ideal for combination
7. Nontoxic to liver, kidney, and brain; quickly removed from the lungs.
8. Inexpensive.

Disadvantages

1. Less potent—used with other agents.
2. Poor muscle relaxant.
3. NO_2 displaces nitrogen in the air-filled cavities and it enters the cavities faster, i.e., even before nitrogen escapes. This results in expansion of such cavities leading to pneumothorax and air embolus. Hence, NO_2 should be avoided in such patients.

JAYPEE BROTHERS



4. Repeated use can depress the bone marrow.
5. Long-term exposure (like in staff of operation theater) to low doses
   - ➢ It can impair deoxyribonucleic acid (DNA) synthesis resulting in fetal abnormalities on conception.
   - ➢ It may cause vitamin B_{12} deficiency.

Status in Anesthesia

Adjuvant—nitrous oxide (~50%) with oxygen (30%) is used to provide analgesia and sedation with other anesthetics.

Ether: Ether is a colorless volatile liquid, a potent and reliable anesthetic with good analgesic and muscle relaxant properties. However, it is highly inflammable, induction and recovery are slow and unpleasant, and vapors are irritating, hence ether is not used.

Comparison of Ether, Nitrous Oxide, and Halothane

COMPARE AND CONTRAST
Ether, Nitrous Oxide, and Halothane

Features	*Ether*	*Nitrous oxide*	*Halothane*
State	Liquid	Gas	Liquid
Potency	Good	Low	Good
Flammability	Inflammable	No	No
Irritant property	Yes	No	No
Analgesia	Good	Good	Poor
Effect on CV function, respiration	Not significant	Not significant	Significant (depressant)
Muscle relaxation	Good	Poor	Very poor
Risk of hepatitis	No	No	Yes
Induction and recovery	Unpleasant and slow	Smooth and rapid	Smooth and rapid
Use in anesthesia	Rarely used	As adjuvant along with oxygen	Was used but now not preferred

Halothane

Q. Describe briefly the advantages and disadvantages of halothane as an anesthetic.

Halothane is a colorless volatile liquid with a sweet odor.

Advantages

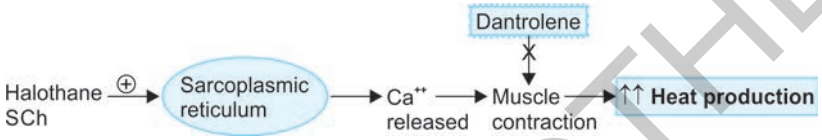
1. Potent and noninflammable anesthetic.
2. Induction is smooth and rapid—surgical anesthesia in 2–5 minutes.
3. Nonirritant—no increased secretions.

JAYPEE BROTHERS

4. Recovery is rapid.
5. Less postoperative nausea and vomiting.

Disadvantages

1. Not a good analgesic and not a muscle relaxant.
2. Direct myocardiac depressant—↓ heart rate, cardiac output, and BP. It sensitizes the heart to the arrhythmogenic effects of adrenaline.
3. Mild respiratory depression.
4. Severe hepatitis—may be fatal (1: 50,000).
5. Reduces renal blood flow and GFR.
6. **Malignant hyperthermia**—a genetically determined reaction—rare but can be fatal → treated with dantrolene.



7. Cerebral vasodilation → ↑ Cerebral blood flow → ↑ Intracranial pressure → Avoid halothane in intracranial tumors and cerebral edema

Status in anesthesia: Halothane was a popular anesthetic but it is toxic to heart, lungs, kidney, liver, and brain and therefore its use has largely declined as the newer safer derivatives are available.

Q. Write a short note on enflurane/isoflurane/desflurane/sevoflurane.

Enflurane	*Isoflurane*	*Desflurane*
Similar to halothane except: • Metabolized to a lesser extent than halothane—therefore safe for liver • Does not sensitize the heart to adrenaline • May precipitate seizures in epileptics → avoid • A metabolite of enflurane is nephrotoxic	Differs from halothane as: • More potent • Does not sensitize the heart to adrenaline → safer in MI • Metabolism is negligible (99% excreted through lungs) → safe for liver • Doesn't provoke seizures • Preferred in neurosurgical procedures (less cerebral vasodilation and less increase in intracranial pressure) • **Extensively used** for maintenance of anesthesia **Disadvantages:** • Can cause hypotension • Requires a skeletal muscle relaxant	1. Has all the advantages of isoflurane 2. Rapid and smooth induction and recovery because of low-solubility in blood and tissues **Disadvantages:** **Pungent** → may induce coughing, laryngospasm → not preferred for induction **Low volatility** → a special vaporizer required for administration **Sympathetic stimulation** → HR

JAYPEE BROTHERS

Sevoflurane

Sevoflurane has many advantages and is now the preferred anesthetic.

Advantages

1. It is not pungent.
2. It has a rapid and smooth induction and recovery because of low-solubility in blood and tissues.
3. It is a good bronchodilator.
4. It is suitable for day-care surgeries and in children.

Disadvantages

1. Chemically unstable → degraded by CO_2 adsorbents (soda lime) to a nephrotoxic metabolite.
2. Postoperative restlessness—premedication with midazolam needed.
3. Metabolized (~3%) in the liver → nephrotoxic fluoride ions released.
4. Precipitates malignant hyperthermia in genetically susceptible individuals.

Xenon

Q. What are the advantages and disadvantages of xenon?

Xenon is an inert gas. It has properties very close to an *ideal anesthetic.*

Advantages

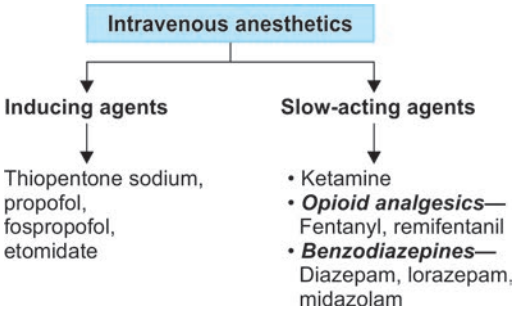
1. Rapid induction → insoluble in blood and tissues.
2. Rapid recovery.
3. Good anesthetic.
4. No effect on hepatic, renal, or pulmonary function.
5. No significant CV effects—no effect on CO, HR or BP.
6. Not metabolized in the body.

Disadvantage

Very expensive because xenon cannot be manufactured currently but can only be extracted from air.

INTRAVENOUS ANESTHETICS

Q. Discuss briefly about the different intravenous anesthetics.



Advantage

Extremely rapid induction because the blood concentration can be raised rapidly and in one arm-brain circulation (~11 seconds) there is loss of consciousness.

JAYPEE BROTHERS

Table 4.2: Intravenous anesthetics.

Drug	*Main features*	*Uses*
Thiopental	• Fast and smooth onset of action (20–30 seconds)	For induction
	• CV and profound respiratory depression	Medicolegal use—truth serum
Propofol	• Fast onset and recovery • Pain at the injection site • CV and respiratory depression • Antiemetic property	Short procedures
Etomidate	• Fast onset and recovery • Less CV and respiratory depression • Involuntary movements during induction • Suppresses adrenal steroidogenesis • Pain at the injection site	For induction—(particularly in patients with low cardiovascular reserve)
Ketamine	• Slow onset • Good analgesia and amnesia • No respiratory depression and no hypotension • ↑ BP • Hallucinations and involuntary movements during recovery	Short procedures particularly in children
Midazolam	• Slow onset and recovery • Less CV and respiratory depression	Short procedures such as endoscopy and fracture reduction
Fentanyl + droperidol	• Slow onset and recovery • Profound analgesia	Short procedures

(BP: blood pressure; CV: cardiovascular)

Disadvantages

- Anesthetics given IV have no channel for quick elimination like the lungs.
- Elimination of inhaled anesthetics can be made faster by hyperventilation but not possible with IV anesthetics.

Hence IV anesthetics are used only for induction because of the rapid onset of action and anesthesia is maintained by an inhalational agent **(Table 4.2)**.

Thiopentone Sodium

Q. Write a short note on thiopentone sodium.

Thiopentone sodium is an ultra-short-acting barbiturate. On IV injection it produces unconsciousness in 20–30 seconds. Duration of action is 4–7 minutes. It is highly lipid-soluble, rapidly crosses the blood-brain barrier (BBB) and gets rapidly redistributed in the body tissues leading to termination of its action.

Advantages

1. Quick onset of action
2. Induction is smooth, rapid, and pleasant.

JAYPEE BROTHERS

Disadvantages

1. Not a good analgesic
2. Not a muscle relaxant.
3. **Respiratory, CV** depression → cannot be used alone.
4. Severe hypotension, hiccups possible.
5. Should not be mixed with acidic drugs because barbiturates may be precipitated.
6. Repeated use → accumulates in fat.
7. Extravasation → intense pain, necrosis, and gangrene. Inj into an artery → severe vasospasm.

Uses of Thiopental

1. Induction of anesthesia.
2. To control convulsions in status epilepticus.
3. Medicolegal use—**'truth serum'** for interrogation of suspects, subanesthetic doses of thiopentone sodium produces altered consciousness when the capacity of a person to concoct stories and lie is lost.

Propofol

Q. Discuss the role of propofol in general anesthesia.

Propofol is an oily liquid with several advantages and is **most preferred** IV anesthetic.

Advantages

1. Quick induction and rapid recovery.
2. Because of rapid recovery, it is preferred for 'day cases'.
3. It has antiemetic property.
4. It can be safely used in pregnant women.

Disadvantages

1. Respiratory depressant.
2. Vasodilation → fall in BP.
3. Negative inotropic effect → depression of cardiac contractility.
4. Pain on injection—prevented by diluting + adding lignocaine.
5. **'Propofol infusion syndrome'** → skeletal muscle necrosis, metabolic acidosis, hyperkalemia, renal failure, arrhythmias, and CV collapse—but rare.
6. Histamine release and anaphylactoid reactions.

Uses

1. For **induction** and maintenance of GA for short procedures of up to 1 hour duration. The effect of a single dose is terminated by **redistribution**.
2. **Total IV anesthesia**—continuous infusion or intermittent injection for short surgical procedures such as endoscopies and burns dressing in poor risk patients.
3. **Postoperative nausea** and **vomiting** in subanesthetic doses.

Fospropofol is a prodrug of propofol. It does not cause pain at the injection site (propofol causes pain) but the onset of action and recovery are slow because it is a prodrug.

JAYPEE BROTHERS

Ketamine

Q. Write a short note on ketamine.

Ketamine produces a trance-like state known as **dissociative anesthesia** characterized by intense analgesia, immobility, amnesia, and a feeling of dissociation from the surroundings with or without actual loss of consciousness. Ketamine is **highly lipid-soluble**, gets **rapidly distributed** and then redistributed to less vascular structures. Dissociative anesthesia starts within 3–5 minutes and lasts for 10–15 minutes. Amnesia lasts for 1–2 hours.

Mechanism of action: Ketamine acts by **blocking the N-methyl-D-aspartate (NMDA) receptor** which is an excitatory amino acid receptor.

Advantages:

1. **Provides good analgesia (only IV anesthetic to provide analgesia) and amnesia**.
2. No respiratory depression and no hypotension.
3. Convenient to use—epidural, IV, IM, and rectal.
4. **Particularly suitable** in **children, poor risk patients,** and in **asthmatics** as it may produce bronchodilatation.
5. Increases HR, CO, and BP—useful in poor risk cardiogenic shock.

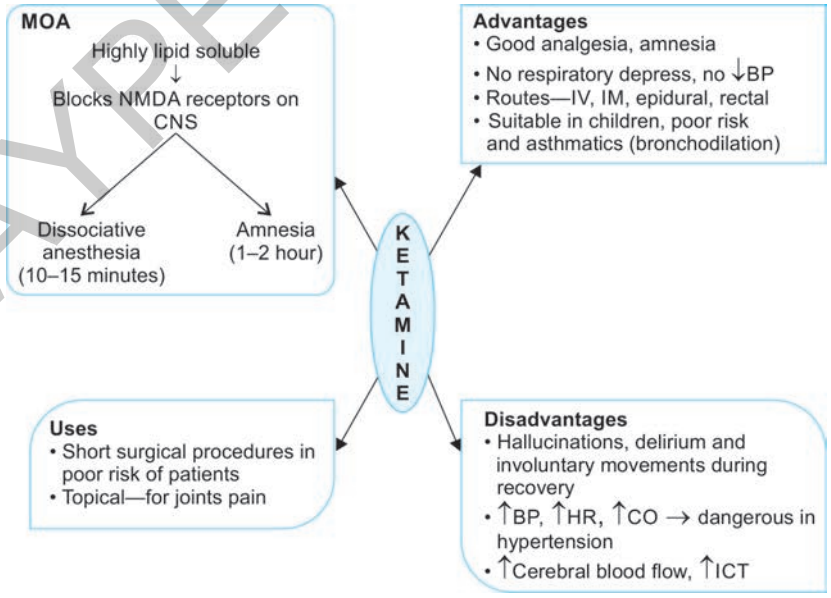
Disadvantages:

1. Hallucinations, delirium, involuntary movements, and nystagmus may occur during recovery. Premedication with diazepam helps.
2. ↑↑ BP, heart rate, and cardiac output—dangerous in hypertensives.
3. ↑↑ Intracranial pressure

Uses:

1. Short surgical and diagnostic procedures particularly in poor-risk patients.
2. **Topical** use for joints pain.

Mind Map of Ketamine



JAYPEE BROTHERS

PREANESTHETIC MEDICATION

PH 1.18: Describe the mechanisms of action, types, doses, side effects, indications, and contraindications of general anesthetics, and preanesthetic medications.

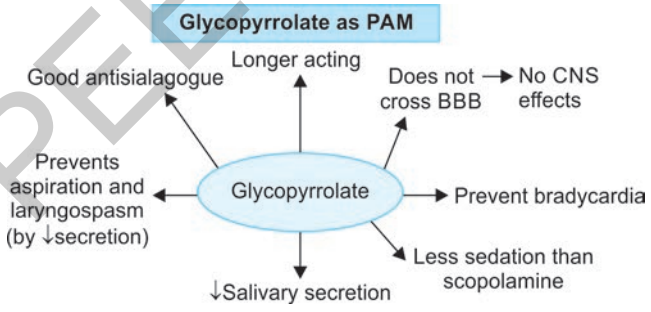
Q. Write briefly on preanesthetic medication. Give reason: Why glycopyrrolate is preferred as preanesthetic medication?

Prior to anesthesia, certain drugs are administered in order to make anesthesia safer, more pleasant, reduce anxiety and side effects of anesthetics and is known as preanesthetic medication (PAM). Preanesthetic medication is given in order to:

To achieve the purpose, more than one drug is required. They are:

1. **To reduce anxiety, produce sedation and amnesia:**
   - **Sedative hypnotics:** Benzodiazepines (like lorazepam or midazolam) reduce anxiety, produce sedation, and also amnesia.
   - **Antihistamines** for sedative, antiemetic, and anticholinergic properties, e.g., promethazine.
2. **Antiemetics:** Metoclopramide, domperidone or ondansetron may be used for antiemetic effects.
3. **To reduce salivary secretions:** During anesthesia, the secretions from the oral cavity and trachea may creep into the larynx inducing laryngospasm. They may enter into the lungs causing aspiration pneumonia.
   - **Anticholinergics:**
     a. Reduce the secretions—good antisialagogues
     b. Prevent bradycardia due to vagal stimulation
     c. Prevent laryngospasm which is due to excessive secretions.

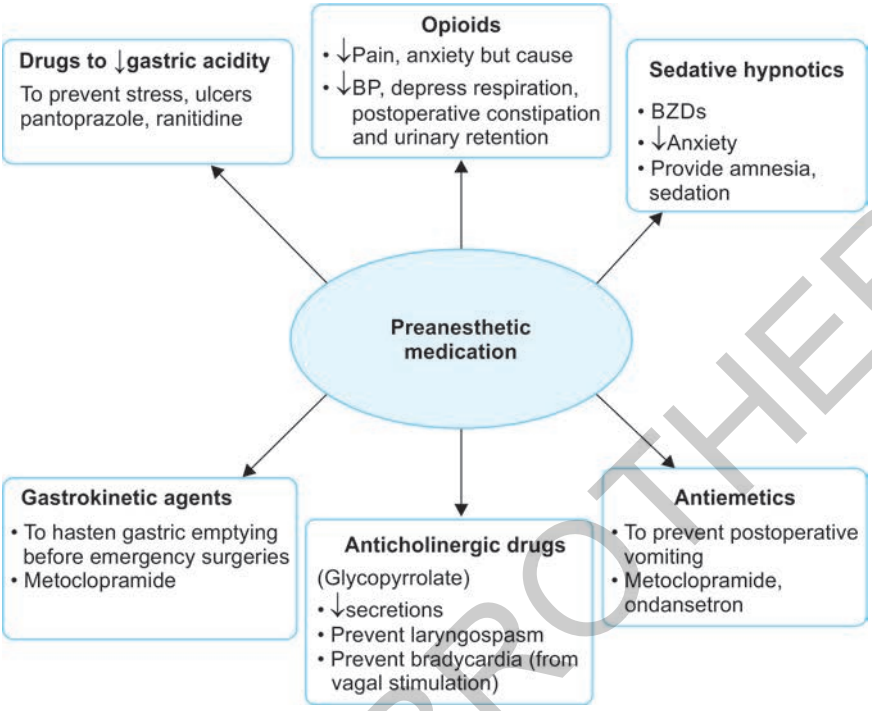
     Though atropine, scopolamine can be used, glycopyrrolate is preferred.
   - **Glycopyrrolate** is preferred as preanesthetic anticholinergic because:



4. **To reduce gastric acidity:** General anesthetics may induce vomiting with an increased risk of aspiration into the respiratory tract because normal protective airway reflexes are depressed by anesthetics. Aspiration of the acidic gastric contents into the lungs cause damage to the lungs. Proton pump inhibitors like pantoprazole, H_2-blockers like **ranitidine** decrease gastric acid secretion and reduce the damage to lungs if aspiration occurs while on anesthesia.
5. **To promote gastric emptying:** Metoclopramide is a dopamine antagonist that promotes gastrointestinal motility **(Gastrokinetic)** and increases the tone of esophageal end of the stomach. This speeds up gastric emptying

JAYPEE BROTHERS

Mind Map of Preanesthetic Medication



particularly in emergency surgeries. The combination of H_2-blocker + metoclopramide provides best protection against aspiration.

6. **To relieve pain—pre and postoperatively: Opioids** like morphine and pethidine reduce anxiety and apprehension, provide analgesia and reduce the dose of the anesthetic required. However, they depress respiration and may cause hypotension, postoperative constipation, and urinary retention; precipitate asthma and delay recovery.

Conscious sedation: It is a state when the patient has sedation and amnesia without being unconscious. Such a state is attained by combination of a **sedative** and **an analgesic midazolam/propofol + fentanyl,** the patient responds to commands but is drowsy. For longer action, **diazepam + pethidine** → reasonably safe as antidotes for both drugs are available (flumazenil and naloxone). Propofol may be used in place of midazolam.

Indications are minor surgical and diagnostic procedures. In addition, regional block with local anesthetics may be used for short surgical procedures. Avoided in chronic obstructive pulmonary diseases (COPD) or psychotic patients and in pregnancy.

Balanced anesthesia: Since it is not possible to achieve ideal anesthesia with a single drug, multiple drugs are used to attain this like—preanesthetic medication, IV anesthetics for induction, inhalational agents for maintenance, oxygen, skeletal muscle relaxants and analgesics. This is termed balanced anesthesia.

JAYPEE BROTHERS

for detailed information on pharmacology books, visit our website www.jaypeebrothers.com, for detailed information on pharmacology books, visit our website www.jayp

Exam Preparatory Manual
for Undergraduates

PHARMACOLOGY

Salient Features

- The book is complete with all topics as per revised competency-based medical education (CBME) syllabus.
- It has a student-friendly format.
- More figures and flowcharts are added.
- Text is thoroughly revised and organized.
- Compare and contrast series improve depth.
- More mnemonics are mentioned to help memorize the topics.
- Exam-oriented—helps quickly cover the entire subject.

Padmaja Udaykumar MD is working as Professor and Head of the Department of Pharmacology at Father Muller Medical College Mangaluru, Karnataka, India. She is the Former President of the National Association of Pharmacology and Therapeutics, a reputed body working for the upliftment of pharmacology. She has a keen interest in medical education with over 30 years of teaching experience and has served on the boards of studies of many universities. She has published several titles, and this is the 27th book in the series of textbooks meant for medical, dental, nursing, physiotherapy, and pharmacy students. She also has several research papers to her credit. She has rich experience in clinical pharmacology, has conducted and coordinated several clinical trials, and has been advising clinicians on the appropriate and rational use of drugs.

Printed in India

Available at all medical bookstores or buy online at www.ejaypee.com

JAYPEE BROTHERS
Medical Publishers (P) Ltd.
EMCA House, 23/23-B, Ansari Road,
Daryaganj, New Delhi - 110 002, INDIA
www.jaypeebrothers.com

Join us on facebook.com/JaypeeMedicalPublishers
Follow us on instagram.com/JaypeeMedicalPublishers

Shelving Recommendation
PHARMACOLOGY

ISBN 978-93-5696-633-8