GENERAL ANESTHESIA

Def.: CNS depressant, characterized by: loss of consciousness, loss of sensation & adequate m. relaxation.

Stages of GA.:
1- Stage I: Stage of induction or analgesia
2- Stage II: Stage of excitement or delirium (Dilated reactive pupil)
3- Stage III: Stage of Surgical anesthesia (Normal pupil)
   It is divided into 4 Planes
4- Stage VI: Stage of medullary paralysis (Dilated non-reactive pupil)

Mechanism of action:
Either:
- ↑GABA
- ↓NMDA of Glutamate

Classification:

\[
\begin{array}{c|c|c}
\text{Inhalation} & \text{I.V.} \\
\hline
\text{Gases} & \text{Volatile liquide} & 1- \text{Ultra short Barbiturate} \\
\text{Nitrous Oxide} & 1- \text{Halothane} & 2- \text{Non Barbiturate:} \\
 & 2- \text{Enflurane} & - \text{Benzodiazepines} \\
 & 3- \text{Isoflurane} & - \text{Propofol} \\
 & 4- \text{Desflurane} & - \text{Propanidid} \\
 & 5- \text{Methoxyflurane} & - \text{Neurolept analgesia} \\
 & 6- \text{Trichloro-ethylene} & - \text{Etomidate} \\
 & 7- \text{Ethylchloride} & - \text{Ketamine} \\
 & 8- \text{Ether (obsole} & \\
 & \text{te)} & \\
 & 9- \text{Chloroform (obsole} & \\
 & \text{te)} & \\
\end{array}
\]

N.B.:
- Most of anesthetics stop respiration before circulation, while chloroform stops respiration with circulation
- Recovery occurs in reverse order. CO\textsubscript{2} & O\textsubscript{2} administration can fasten recovery in inhalation anesthesia
- The onset of action of anesthetic depends on its solubility in blood, thus:
  - \text{N}_{2}O has low solubility & rapid onset, while
  - Methoxyflurane has high solubility & delayed onset.
Anesthesia

Inhalation anesthesia

<table>
<thead>
<tr>
<th>Halothane</th>
<th>N\textsubscript{2}O</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages:</strong></td>
<td><strong>Advantages:</strong></td>
</tr>
<tr>
<td>1- Non-inflammable &amp; non-explosive</td>
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<tr>
<td>2- Non-irritant</td>
<td>2- Non-irritant</td>
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<tr>
<td>3- Produces broncho-dilatation</td>
<td>3- Rapid induction &amp; recovery</td>
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<tr>
<td>4- Produces controlled hypotension</td>
<td>4- Good analgesics in labour</td>
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<tr>
<td>5- Safe on :CVS , Resp., Vital organs</td>
<td></td>
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<tr>
<td><strong>Disadvantage:</strong></td>
<td><strong>Disadvantage:</strong></td>
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<tr>
<td>1- Weak analgesic</td>
<td>1- Weak anesthetic</td>
</tr>
<tr>
<td>2- Weak sk.m. relaxants</td>
<td>2- Weak sk.m. relaxants</td>
</tr>
<tr>
<td>3- Uterine relaxant</td>
<td>3- Produces <strong>Diffusion hypoxia:</strong> during recovery it diffuses rapidly ( \Rightarrow \downarrow \text{O}_2 ) conc. In alveoli ( \Rightarrow ) Hypoxia, so give \text{O}_2 during recovery</td>
</tr>
<tr>
<td>4- <strong>Cardotoxic:</strong></td>
<td>4- <strong>Megaloblastic anemia</strong></td>
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<tr>
<td>- Stage 1: Bradycardia</td>
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<tr>
<td>- Stage 2: <em>sensitize the heart to catecholamine</em> ( \Rightarrow ) arrhythmia</td>
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<tr>
<td>- Stage 3: direct depressant</td>
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<tr>
<td>5- <strong>Hepatotoxic</strong></td>
<td></td>
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<tr>
<td>6- <strong>Malignant hyperthermia</strong></td>
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<tr>
<td>7- Expensive</td>
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</table>

**N.B.:**
- **Enflurane**: As Halothane but *no hepatic toxicity* & *less sensitization of heart* to catecholamines

- **Isoflurane & Desflurane**: As Enflurane but: *do not sensitize heart* to catecholamines.

- **Methoxyflurane**: Cardiotoxic & Nephrotoxic

- **Balanced anaesthesia**: \( \text{N}_2\text{O} + \text{Halothane} \)

**Minimal alveolar anesthetic concentration (MAC):**
- **Definition**: It is the minimal alveolar anesthetic concentration at which 50 % of patients do not respond to a surgical stimulus

- **Importance**: it is a measure of anesthetic *potency*, MAC is small for potent anesthetics, as halothane & large for weak anesthetics as \( \text{N}_2\text{O} \)
I.V. Anesthesia

Advantages:
- Easy
- Rapid induction & recovery
- No irritation of respiratory tract
- No sensitization of heart to catecholamines
- No post-operative nausea or vomiting
- No explosive hazards

Disadvantages: Once injected, cannot be withdrawn

1- Ultrashort Barbiturate
Thiopental, Methohexital & Hexobarbital

*Kinetics:* - Rapidly absorbed
- Passes BBB & Placental barrier
- Fate: Redistribution & slow metabolism ➔ Accumulation

**NB.:**
1- Methohexital is metabolized faster ➔ Rapid onset – rapid recovery – little effect on Bl.Pr.
2- Thiopental (highly alkaline, as it is prepared in the form of Na solution) should **not** mixed with Succinylcholine (acidic) in the same syringe

*Actions:* - CNS: - Sedation – hypnosis – anesthesia
- Potentiate analgesics
- ↓ H.R.C - R.C - VMC
- CVS: - Large dose ➔ Sudden hypotension due ↓ cardiac contractility
- Respiration: - ↓ RC - Bronchospasm
- Sk.m. relaxation

*Uses:* 1- Induction of G.A  2- Brief G.A  3- Anticonvulsants

*Side effects:* 1- Respiratory complication: Apnea – Bronchospasm  
2- Hypotension  
3- Irritant: Phlebitis – Thrombophlebitis – Pain – Necrosis & slough  
4- **Contraindicated in Acute intermittent porphyria**

2- Benzodiazepines
As: Diazepam – Midazolam – Lorazepam ——— see before

3- Propofol
Rapid induction & recovery

4- Propanidid
- Rapid induction & recovery
- **Metabolised by pseudo-cholinestrase** ➔ its action is intensified by succinylcholine & Anti-cholinestrase.

5- Etomidate
Rapid onset short duration
6-Neurolept analgesia

_Droperidol + Fentanyl = Thalamonal_

- It produces analgesia without loss of consciousness
- Useful in _obestracit & minor procedure_ as bronchoscopy as pt. is cooperative

7- Ketamine

**Actions:**

Produces _Dissociative anasthesia_: [loss of sensation & motor activity + Amnesia + Analgesia without loss of consciousness]

**Side effects:**

<table>
<thead>
<tr>
<th>Contra-indication:</th>
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<tbody>
<tr>
<td>1- Mental disorders</td>
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<tr>
<td>2- ↑ ICT</td>
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<tr>
<td>3- Hypertension</td>
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<td>4- Glaucoma</td>
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</tbody>
</table>

| Uses: To provide analgesia for minor procedure esp. in children |

**Pre-anesthetic medication**

**Benefits:**

1- To produce: sedation , amnesia & analgesia
2- To reduce:
   a- amount of anesthesia
   b- post-anesthetic complications
   c- parasympathetic supply to lungs , salivary gland & heart ➩ ◀ secretions , bronchospasm & reflex vagal stimulation

**Drugs used include:**

1- Narcotic analgesics: Morphine & Meperidine
2- Anxiolytics: Barbiturate - Benzodiazepines - Chloralhydrate - Paraldehyde
3- Neuroleptics as: Phenothiazine group
4- Parasympatholytics as: Atropine & Hyoscine
5- Adjuvant drugs:
   - Neuromuscular blockers
   - Controlled hypotension: [ Trimethaphan – Na Nitroprusside ]
   - Hypothermic agents : by Lytic cocktail [Clorpromazine – Promethazine Meperidine ]

**N.B.:**

1- _Hypotensive drugs_ as Reserpine may lead to severe hypotension
2- _MOA inhibitors_ potentiate the action of Morphine & Meperidine
3- _In Thyrotoxic patients_: Hyoscine is used instead of atropine & curare instead of Gallamine
LOCAL ANESTHESIA

Definition:
Local anesthetics are drugs that cause reversible block of nerve conduction producing transient localized anesthesia without significantly affecting consciousness.

Structure and Chemical aspects:
They are weak bases formed of lipophylic group connected to ionizable hydrophilic group by an intermediate chain; which may be amide or ester.

Classification:

a) According to their chemical structure.

<table>
<thead>
<tr>
<th>L.A</th>
<th>Amides</th>
<th>Esters</th>
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<tbody>
<tr>
<td></td>
<td>Lidocaine</td>
<td>Benzoic a. esters</td>
</tr>
<tr>
<td></td>
<td>Dibucaine</td>
<td>Cocaine</td>
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<tr>
<td></td>
<td>Prilocaine</td>
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<tr>
<td></td>
<td>Mepivacaine</td>
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</tr>
<tr>
<td></td>
<td>Bupivacaine</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>PABA esters</td>
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<td></td>
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<tr>
<td></td>
<td>Procaine</td>
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<td></td>
<td>Tetracaine</td>
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<tr>
<td></td>
<td>Benzocaine</td>
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b) According to their solubility and therapeutic application into:

<table>
<thead>
<tr>
<th>L.A</th>
<th>1- Soluble L.A suitable for injection:</th>
<th>2- Soluble L.A used only topically:</th>
<th>3- Insoluble L.A:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lidocaine</td>
<td>Cocaine</td>
<td>Benzocaine</td>
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<tr>
<td></td>
<td>Dibucaine</td>
<td>Phenacaine</td>
<td>Orthoform</td>
</tr>
<tr>
<td></td>
<td>Procaine</td>
<td>Butacaine</td>
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<td></td>
<td>Tetracaine</td>
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</tbody>
</table>

All these can produce surface anesthesia EXCEPT Procaine which is effective ONLY by injection

Mainly used to produce topical anesthesia of the Eye

Used as surface anaesthetics in the form of powders and ointments for wounds.

Kinetics:
1- Pass easily mucous membrane except Procaine
2- Benzocaine & Orthoform are insoluble & are used on skin only
3- Fate: - Esters By plasma psudocholine Estrase enz. (Shorter duration)
   - Amides By hepatic microsomal enzymes.
4- Excreted in urine & Acidification of urine ↑ its excretion
Methods of administration:

1- Surface anesthesia:
   - By direct application for skin & mucous membrane

2- Infiltration anesthesia:
   - By S.C injection to reach fine nerve branches and sensory nerve terminals.

3- Nerve block anesthesia:
   - By injection close to the appropriate nerve trunks (Brachial plexus) to produce a loss of sensation peripherally.

4- Sympathetic block:
   - It is injected around sympathetic ganglion.

5- Para vertebral block:
   - It is injected around spinal roots as they emerge from the paraverterbal foramina.

6- Epidural anesthesia:
   - The LA is injected in the epidural space; between the dura & bony spinal canal containing fat & connective tissue.
   - It can be performed in sacral hiatus (Caudal anesthesia)

7- Spinal:
   - The LA is injected in the subarachnoid space in the lumbar region
   - The level of spinal anesthesia depends upon:
     i. Posture of the patient.
     ii. Specific gravity of the injected solution.

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Mechanism of action:

- They act from inside the nerve & inhibit Na influx
  - membrane stabilization

- Fibers are affected in this sequence (Sensory, cold, touch, pressure & lastly motor) & unmyelinated before myelinated.
- Recovery occurs in the reverse direction

Factors modifying action:

1- Extracellular pH: increased pH (alkaline medium) ↑ the action due to ↑ non-ionised forms ↑ their absorption to act from inside & vice versa
   - **(Acidosis as in inflammation ↓ the action)**

2- Extracellular ions:
   - ↑Ca antagonize the action
   - ↑K enhance the action

3- Intracellular pH: ↑ tissue level of CO₂ ↑ intracellular acidosis accumulation of ionized form ↑ the action

4- Hyaluronidase enz. ↑ Onset, spread & depth of action

5- V.C. as Adrenaline prolongation of action
Anesthesia

Actions
1- Local anesthetic action
2- C.N.S.: stimulation (tremors, convulsions) followed by depression
3- C.V.S.: - Heart ➔ Quinidine like except Cocaine
   - B.V. ➔ VD except Cocaine which produce VC
4- Smooth muscle: spasmolytic

Toxicity of L.A.:
A- Systemic:
   1- Allergy: esp. with ester type
   2- Methaemoglobinemia with Prilocaine
   3- C.V.S.: - Shock
      - Vasovagal syncope [Bradycardia – Hypotension – fainting]
   4- C.N.S.: stimulation then depression
      NB.: PABA esters as procaine are hydrolysed into PABA, so antagonize the
      effect of sulphonamides

B- Local:
1- Pain at site of injection
2- Persistent paraesthesia or anesthetic effect.
3- Haematoma.
4- Oedema.

C- Toxicity of spinal anesthesia:
   a- Early:
      - Hypotension: due to arterio-dilatation & veino-dilatation
        ttt by [elevate legs – I.V. fluids – sympathomimetics]
      - Respiratory paralysis
   b- Late:
      - Septic meningitis
      - Headache in 10% of patients

Contraindications:
1- Advanced liver disease (no enzyme to metabolize it).
2- In hypertensive patients ➔ give L.A. alone without adrenaline or
   noradrenaline
3- Thyrotoxicosis and heart disease ➔ give L.A. with noradrenaline but NOT
   adrenaline