Inhalational Anaesthetic

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• Anaesthesia is a Latin word
• Ane (without), esthesia (sensation) = without sensation.
Goals of anaesthesia

1. Analgesia
2. Muscle relaxation
3. Amnesia
4. Loss of protective reflexes (coughing, hiccups, etc.)
5. Make the patient unconscious

• Note: no single dx can do all these effectively and safely so in anaesthesia process we use multiple agent usually.
Anaesthesia selection

1. Procedure being performed (appendectomy different than amputation)
2. Patient factors
   • Respiratory system
   • Cardiovascular system
   • Liver and kidney dysfunction
   • Drugs & medications
Types of anaesthetic drugs

- For any dx to be general anaesthetics it needs to cross the BBB
- For it to cross the BBB it needs to lipid soluble And have small molecular weight
Stages of anaesthesia

Stage 1: Induction
Stage 2: Excitement
Stage 3: Surgical Anesthesia
Stage 4: Medullary Paralysis
Mechanism of action for general anaesthetics

they are not clearly understood but here what we know about them:

• Macroscopic level

• At molecular level

1. **GABA receptors** (good anaesthesia but weak analgesia)

2. **NMDA receptors** (good analgesia but weak anaesthesia)
Lets start ..... Inhaled anaesthesia

• Inhaled agents usually are used to maintain anaesthesia after induction with IV agents, why??
• In children we usually induce anaesthesia by inhaled agents directly without iv agents.
How to measure the potency of Inhaled agent??

• By MAC (minimum alveolar concentration) : it’s the percent of gas required in mixture to reach 50% of anaesthesia.

• Low MAC = high potency .

• Similar to ED50 but the inhaled version.

  • Factors affecting MAC
    1. Patient related (elderly lower MAC)
    2. Drug related (more lipid soluble more potent ,so lower MAC)

\[
\text{Lipid Solubility} = \frac{1}{\text{MAC}}
\]
## Factors Affecting MAC

<table>
<thead>
<tr>
<th>Increase</th>
<th>Decrease</th>
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<tbody>
<tr>
<td>MAO Inhibitors</td>
<td>Opioids</td>
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<tr>
<td>Cocaine</td>
<td>Barbiturates</td>
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<td>Amphetamines</td>
<td>Benzodiazepines</td>
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<td>Chronic Alcoholism</td>
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<td>Hyperthermia</td>
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<td>Ephedrine</td>
<td>Hypoxia</td>
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<td>Other</td>
<td>Other</td>
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Factors affecting function of inhalation anaesthetic agents: 3 Questions.

1. **Alveolar wash in**: How fast anaesthetic gas reach the alveolus?
   - Respiratory rate
   - Concentration of drug

2. **Anaesthetic uptake**: How fast the anaesthetic agent pass to blood and act on the brain?
   - Gradient between air and blood (as concentration increase in blood it will be harder for gas to diffuse from alveoli to capillaries)
   - Cardiac output
   - Solubility in blood “more in next slide”

3. **Anaesthesia wash out**: How much it takes for anaesthetic effect to finish?
   - Effects on different tissue (fat tissue can store more of drug than muscles so fatter people will stay in anaesthetic state for longer time)
   - The more lipid soluble the drug is the more it stays in body.
To sum up;

Solubility of gas for blood determines speed of onset/offset.

Solubility of gas for lipids determines potency.

- Examples to understand...
  - Halothane more fat soluble so more potent (low MAC) But because it’s more blood soluble so it has a slower onset of action.
  - N2O less fat soluble so less potent (high MAC) But because it’s also less soluble in blood it has faster on/off action.
Now let's talk about specific Inhalation agents

• We can divide them into two groups; (there are more but for the sake of our lesson)

1. Volatile halogenated hydrocarbon
   • Chemical compounds ends with –ane (halothane, enflurane, etc..)

2. Nitrous oxide (n2o)
   • It’s not nitric oxide (NO) don’t mix things up
Nitrous Oxide

- Nitrous oxide (N2O; laughing gas) is colorless and essentially odourless gas.
- Low potent inhaled anaesthesia with high **MAC of 105%**
- Often used in dentistry offices.
- **Good analgesia but weak anaesthesia** because it acts on NMDA receptors. (NMDA antagonist)
Mechanism of action
Effects on Organ Systems

- **Cardiovascular**; no marked changes.
- **Respiratory**; depress respiratory system by increases respiratory rate (tachypnea) and decreases tidal volume.
- **Cerebral**; increasing CBF and ICP.
- **Neuromuscular**; In contrast to other inhalation agents, nitrous oxide does not provide significant muscle relaxation.
- **Kidney and liver**; decrease blood flow to kidney and liver but to a lesser extent than with the volatile agents.
Side Effects of N2O

• It’s safe drug has little toxic effect.

• No significant side effect other than post-op nausea and vomiting **BUT** in certain conditions there are more troubling side effects. (secondary gas effects and diffusion hypoxia) “more in next slide”

• N2O diffuses rapidly into air spaces and increase its volume, so in patients with pneumonia and abdominal distension; the N2O will go into these closed cavity and will double its size.
Secondary gas effect

(the N2O will be absorbed very quickly that it will lead increase concentration of other anaesthetic agent in alveoli)
Diffusion Hypoxia

- 35% N₂O
- 14% O₂
- 1% Halothane

- 35% N₂O
- 14% O₂
- 1% Halothane

↑ N₂O
↓ O₂
This means hypoxia

Effec GSI

N₂O

(How to it??)

O₂
Thank You