Pharmacology- Inhalant Anesthetics

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Introduction

Maintenance of general anesthesia is primarily carried out using inhalation anesthetics, although intravenous anesthetics may be used for short procedures.

Inhalation anesthetics provide quicker changes of anesthetic depth than injectable anesthetics, and reversal of central nervous depression is more readily achieved, explaining for its popularity in prolonged anesthesia (less risk of overdosing, less accumulation and quicker recovery) (see table 1)

Table 1. Comparison of inhalant and injectable anesthetics

Inhalant Technique	Injectable Technique

Figure 2. The rise of alveolar partial pressure (P_A) toward the inspired partial pressure (P_I) in different volatile anesthetics.

Anesthetic elimination or recovery from inhalation anesthesia results from the elimination of anesthetic from the brain.

This process is simply the reversal (wash-out) of the anesthetic uptake so the prominent factors affecting the recovery are the same as those for anesthetic induction.

Alveolar concentration of inhalant reflects the amount in the brain

Factors governing the alveolar concentration of inhalants

Alveolar anesthetic concentration primarily depends on (see table 4)

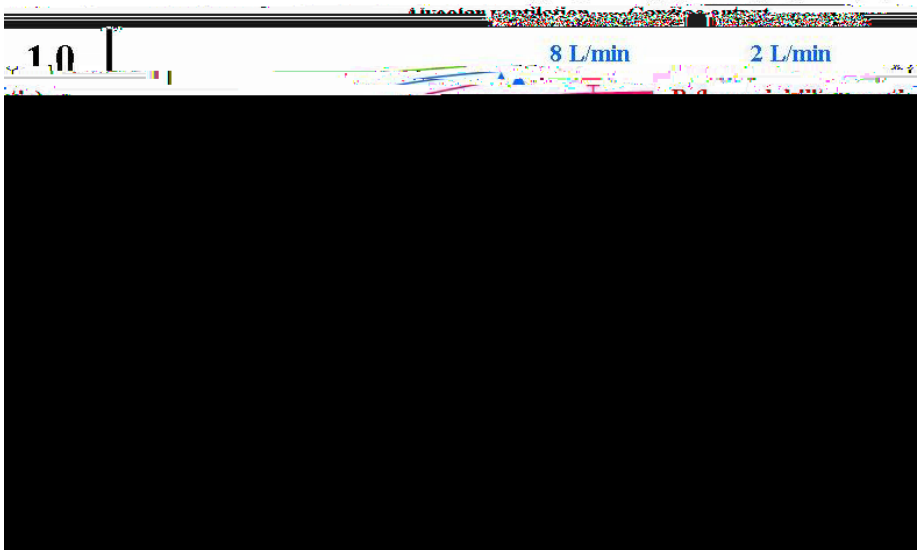
a.

Volatility (boiling point).

- Induction can be speeded by increasing the concentration of anesthetic gas inspired.
- However, the concentration that can be obtained is governed by the volatility of the agent. (NB, with very volatile agents, it may not be safe to use maximal possible concentrations for other reasons).

Alveolar ventilation

The inspired gases reach the alveoli, where gas exchange takes place.
Initially there should be a rapid rise in alveolar concentration, but this is contra-balanced by the solubility of the inhalant anesthetics.
The better a patient breathes in, the better the gas exchanges, and the faster the patient gets anesthetized.
Increased alveolar ventilation, like P_I


1.0
8 L/min
2 L/min

Agents no longer in regular current use

Nitrous oxide

Presented in blue cylinders filled with liquid N_2O.
Boiling point low, so vaporizes in cylinder, and obtained from cylinder as a gas.
MAC above 100%, so cannot be used on its own.
Much more wide spread use in human medicine than in veterinary medicine.
Ensure at least 30% O_2 is given.
Advantages:

- Very insoluble in blood and in fat, so rapid uptake and elimination.
- May also speed up induction with other agents by the "second gas effect".
- Excellent analgesia and its use reduces the concentration of halothane required.
- Little cardiovascular or respiratory depression and very safe as long as sufficient oxygen (30%+) is given.

Disadvantages:

- Limited potency.
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Nephrotoxic if used for very prolonged periods, and for this reason now no longer used in man. This meant the flow of the product into the veterinary market also was influenced, and this product is no longer available in the US.

Good for use in small animals, but its low saturated vapor pressure prevents its use in horses.

Very obvious smell gives some people very severe headaches, so good scavenging essential.

High liver metabolism (~50%), so best to avoid in liver diseased patient.

Enflurane

This is much less soluble than halothane so that induction and recovery are faster.

MAC is about 2% and, clinically, following intravenous induction, end-tidal concentrations of about 2.3% in oxygen appear to produce satisfactory anesthesia.

However, in dogs the anesthetic dose is close to the convulsant dose, making it very difficult to obtain smooth anesthesia.

Signs of anesthesia differ from usual, the dog's eye becoming central at much lighter levels of anesthesia than for other agents.

In the horse the rapid recovery is associated with emergence excitement.

In man it is primarily used with neuromuscular blocking agents.

Liver metabolism is low, but does occur.

Cyclopropane

A very good agent in that it is very insoluble so that induction and recovery are rapid, but explosive.

So now rarely used (if still available?)

Chloroform

The earliest agent used dating back mid 19^{th} century.

Fairly fast and quiet induction and recovery.

Good analgesia and fair muscle relaxation.

Dose related respiratory and cardiovascular depression.

However, sensitizes heart to epinephrine-induced arrhythmias (far worse than halothane in this respect).

Liver toxic.

Not used now except in the horse usually by those who feel comfortable with this agent through their previous exposure and experiences, where 'Standing' chloroform can still be useful.

Premed with acepromazine to reduce the chance of epinephrine induced fibrillation.

Trichlorethylene

Excellent analgesic, but causes rapid jerking respiration, which makes stabilization of anesthesia difficult unless neuromuscular blocking agents are employed.

Must not be used with soda lime!, as breaks down to toxic compounds.

? if still available but was still used in human cardiac work in the 1980's.

Ether